

RAILROAD GAZETTE

SATURDAY, OCTOBER 18, 1873.

Axle-Box Used on the Kaiser Ferdinand Nordbahn of Austria.

The accompanying engraving, taken, with the description, from *Engineering*, illustrates the standard axle-box for cars, of all descriptions, now in use on the Kaiser Ferdinand Nordbahn of Austria:

The box was designed by the Locomotive Superintendent, or Master Mechanic of the line, Ludwig Becker, after a long and careful course of experiments. As long ago as 1861 Mr. Becker, who was then Locomotive Superintendent of one of the Austrian State railways, commenced experimenting on the lubrication of railway axles with mineral oil; but at first with unfavorable results. Mr. Becker, however, persevered with his trials, and in 1863 the difficulties had been to a great extent surmounted, and a large number of carriages were running regularly with this lubricant, the result being a most important saving in cost of lubrication. The first Austrian railway on which the mineral oil was largely employed was the Kaiserin Elisabeth Westbahn, on which line the axle-boxes are almost all of the class known in Austria as Paget's, the space below the axle bearing being packed with wool, and the lubricant being employed to saturate this packing. On Mr. Becker being appointed to his present position on the Kaiser Ferdinand Nordbahn, he naturally extended his application of mineral oil for lubrication; but in order to do this successfully, some further experiments had to be made. The axle-boxes in which the oil had been previously employed had been lubricated from below, in the manner to which we have referred; but, with the exception of those fitted to about 300 vehicles, the axle-boxes in use on the Kaiser Ferdinand Nordbahn were all lubricated from above, while the bearings in use were composed of 60 per cent. lead, 20 per cent. antimony, and 20 per cent. tin, a mixture differing materially from that with which the most successful results had previously been obtained. Mr. Becker, however, continued his experiments, and eventually arrived at most satisfactory results, the standard type of axle box finally arrived at being that shown in our illustrations. Before this, however, Mr. Becker had used the ordinary axle boxes, but with the grease space above the bearing packed with wool and saturated with the mineral oil; and he has given some statistics as to the relative consumption, etc., of the boxes thus fitted, and the Paget box, already referred to. From these it appears that the Paget boxes were filled up every two months, each box taking about half a saltpfund, or say 0.55 English pound of oil, while the wool stopping lasted from twelve to fourteen months, during which period the vehicle would run from about 12,500 to 15,000 English miles. The consumption of oil per axle-box was at the rate of 0.000816 English pound per English mile, while the wear of the bearing was at the rate of 1 pound per bearing for each 31,000 miles run.

The axle-boxes lubricated from the top—the top space being filled with wool—required, on the other hand, to be oiled every 100 to 150 miles (English), and this was, of course, an inconvenience; but as a set-off against this, the economy of lubricating material was greater, the consumption being only at the rate of 0.000653 pound per bearing per mile.

The axle-box finally adopted, and which is represented in the engravings given herewith, is of a very simple type. It consists, as will be seen, of the box proper fitted with a cover having on its underside a semi-cylindrical recess to receive the bearing. This latter is composed of a mixture of 50 per cent. of lead, 25 per cent. of tin and 25 per cent. of antimony, and it is provided at its ends with flanges which prevent it from turning round on its seat. The box beneath the bearing, is filled with a cushion of lime-tree shavings, and a plug at the front provides the means of supplying additional lubrication in cases of emergency. At the back the box is closed by two half-discs of wood, which are cut away so as to lap each other where they meet, and which are held together by a steel wire ring introduced into a recess turned in their outer sides, shown in the longitudinal section of the box. This steel ring, by its elasticity, causes the wooden discs to grip the axle closely, and takes up any looseness caused by wear, the arrangement being a very neat and efficient one.

The two parts of the axle-box are secured together by four bolts, and the top cover is furnished with a screw plug for the introduction of oil, and with a well-fitting secondary cover, by removing which access can be had to the lubricating wick. The arrangement of this wick constitutes the most important feature in the axle-box, and must, therefore, be described in detail. Mr. Becker soon discovered that where mineral oil used as a lubricant is supplied through a wick, it is most essential that this wick should be properly proportioned and arranged. It was in order to insure uniformity in the proportions of the wicks that the arrangement which we are about to describe was devised.

Referring to the views of the box and to the full-size view of the wick, it will be seen that the cotton strands are passed through a tube of sheet iron, this tube being inserted in a cork plug which fits the hole in the box. By this arrangement a wick can be very readily removed and replaced, and the men who attend to the oiling of the axle-boxes are never allowed to tamper with the wicks, but have strict injunctions, if a wick is out of order, to remove it altogether and replace it by a new one. The renewal of the wicks in the lubricating plugs, as they may be termed, is performed by one man, whose duty it is to prepare the wicks for the whole line, and by this means it is secured that the wicks are all composed of a proper number of strands and are fitted up in a strictly uniform manner.

The results which have attended the introduction of this system have been most satisfactory. The boxes of the passenger carriages are oiled every four weeks, and those of the freight wagons every eight weeks, and, as has been stated,

mineral oil is used for lubricating all vehicles. The consumption of oil per axle-box per English mile is only 0.00047 lb., while the experience on the Kaiser Ferdinand Nordbahn shows that the number of hot bearings is equivalent to each bearing running hot once in 19 years. The axle-boxes which are exhibited at Vienna, which are in excellent condition, have been in use from March 18, 1872, to April 18, 1873, thirteen months, during which time they have run 96,128 kilometres, or 59,700 miles, without being repaired or examined.

Besides being employed to the exclusion of all other forms of box on the Kaiser Ferdinand Nordbahn, Mr. Becker's arrangement of axle-box is being extensively used on other Austrian lines, and at the present time these boxes are running under about 16,000 vehicles.

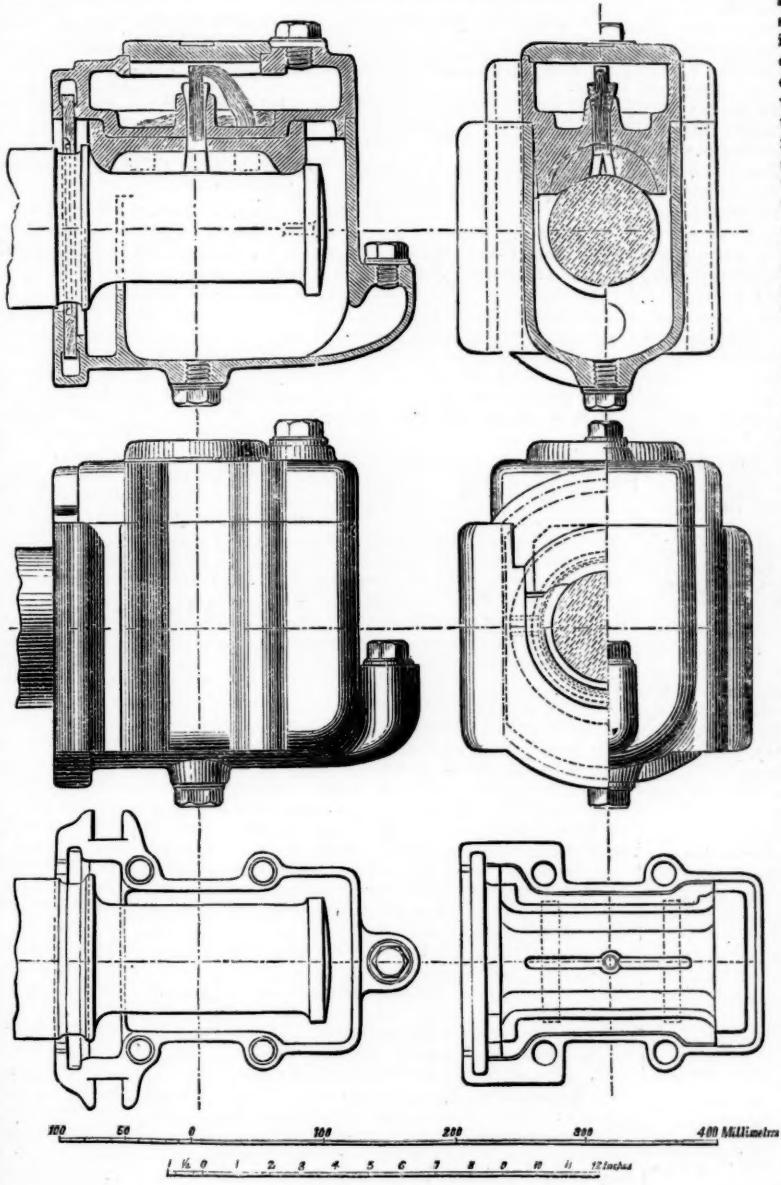
It will be seen that this box differs materially from those in common use on American roads, and it will be interesting to make a careful comparison.

Contributions.

Renewals of Track Materials—More Slip-shod Management—Derailments.

To THE EDITOR OF THE RAILROAD GAZETTE:

Any man who will stand by for a half an hour and watch a gang of track men at work putting new timbers under the frogs



AUSTRIAN AXLE-BOX.

of a three-throw switch, or work of a like nature, and then go and ask for a pass for himself and family, is sufficiently lacking in good moral principles to be entitled to a seat in the Legislature. To see what use is made of the company's hard earnings, and how it is worse than thrown away by the very men it has employed to *preserve and not waste its substance*, and then to seek to drag them still farther into the depths of poverty by a free use of their property, is beyond the least shadow of decency and humanity. Never ask for a pass unless your wife's second cousin has an acquaintance who was once a brakeman. In that case it need not disturb your conscience to *demand a pass on the worst "skinned" road in the country*. This much has been said about passes to bring attention to the fact that many, if not all, railroad companies are troubled with so many leaks in their treasure-box that it would seem that none but a depraved spirit would allow of any such unfeeling act as soliciting a free pass.

This is the way a force of track-men contributed to the general ruin of a road of considerable pretensions the other day. The road extends entirely across one of the Western States, and whatever might be said of its habits and general character, it is certainly very respectably connected.

The decayed timbers had been removed from under some frogs, and the foreman proceeded to "adze them down" at the bearings, and not being skilled in the use of that imple-

ment, the work was very awkwardly done. In adzing the standing upon the timber in the usual and proper manner he cut about half an inch lower on the front than on the back side. Then, in cutting for the opposite frog, he reversed his position, facing in the opposite direction, cutting the front side the lowest as before, which any one not accustomed to the use of the adze is sure to do. When the timbers were held to place for spiking, the frogs and rails had each a bearing on opposite edges of the timber. That is, instead of the frogs having a substantial bearing on the whole width of the timber, they only touched for the width of an inch or two on the corners of the timbers; while a man could easily slip his hand between the frog and timber on the opposite side or corner. The rail on one of the turnouts opposite a frog was first spiked, and the frog gauged to the rail and spiked. Perhaps it is not clear to some what difference it would make, if any, whether the rail or frog were spiked first, so long as they are to be a certain distance apart and spiked to a gauge, but there is this important difference, the "line side" of the track should always be spiked first after being put in good line. Then if the gauge is properly used, the gauge side will conform to the line side, and both sides be perfect. The outer side of a curve should always be taken for the line side, and the other side made to conform to it. The frog is always on the outside of the curve and must be put in line to accommodate both tracks to insure a safe passage of wheels on either track. Now it is obvious that if the rail on the inner side of the curve is spiked first, the frog must be misplaced or sprung out of shape to conform to it, or there will be an inaccuracy of gauge at a point which, above all others, should be perfect. A rail can be curved or shaped to conform to the frog, but a frog is not so accommodating as to yield to any inaccuracies of line or gauge, and must be humdrum to prevent mischieve.

The style of gauge used on this occasion was a slender rod of iron with a spur welded on each end for a measure of the width of the track. Not being capable of withstanding the compression from the heavy rails being thrown against it while placed in position for spiking, it was "sprung" or bent upward in an elliptic form, thus making the track too narrow, so that when the gauge was once removed it "straightened out" and could not be replaced again without being bent as before, or placed diagonally across the track, which was done in this case, and the job pronounced correct. The man who wielded the spike maul made some "glancing" strokes which, when the spike was one-third its length down, bent it over, jamming the head into the throat of the rail in a very unworkmanlike manner. This was frequently repeated, and the spikes, instead of being driven straight, were bent in the form of a sore finger, and would be about as effective in keeping a frog in place as a mess of bruised, bent, twisted and half-broken spikes, half-driven. In this manner these new frogs were placed upon new timbers, which were spoiled by the rough treatment they received, and the new frogs will soon be ruined by being hacked, gouged and knocked loose by wheel flanges as they reel and stagger along the path imperfectly prepared for them.

This is only one instance among many others that might be mentioned where materials, apparently carefully selected, have failed into bad hands on this road, and may in no small measure account for the remarkable frequency of accidents on this line, especially "derailments." Scarcely a day passes without a "run off," varying in results from a slight damage to a general smash-up. This is really too bad, and is entirely the result of bad management.

There seems to be no lack of good materials for putting the track in a first-class condition, and why it is not done "deponent saith not." This line has a local reputation of being the champion road of America for "ditching" trains, but no account of any accident on the road ever reaches the public.

There is something wrong about this, and the stockholders would do well to see to it that when an abundance of supplies are furnished they should be used in a more skillful and economical manner. There are men skilled in the art of making railroad supplies do good service, under whose management there is a constant improvement. There is no scarcity of good men to superintend all manner of road repairs, but the system of economy (?) practiced by many managers has driven the best men to better paying occupations. The man who is possessed of the energy and sound judgment requisite for a good foreman of road repairs will either go into business "on his own hook," or accept of other employment (that men of his abilities can obtain readily) at higher salaries than most railroad companies are willing to pay. The country is swarming with men who consider any advance in wages or position above that of the common laborer a god-send, and are glad to accept any situation offered them at a salary much less than a thoroughly competent man would be paid at almost any other employment. This state of things rather pleases a certain class of economists, who prefer to place these men in charge of expensive

property, which they are as likely to destroy as to use to advantage, rather than pay a salary that will secure the services of competent men and save a thousand times the extra pay in the number of wrecks they would prevent, and the general wear and tear they would save by a judicious use of labor and material.

I have been at some pains of late, while traveling over several roads, to discover the cause or causes of the remarkable frequency and seeming increase of derailments. Some that have come under my immediate notice are easily accounted for, while other cases partake somewhat of the mysterious. Of the latter, more hereafter; but of most cases of accident by derailment it may be said there is nothing very puzzling about them. One thing noticeable in this connection is that the officers of roads on which the most of these accidents occur (for there are roads on which the *most* of them do occur) are very careful that no accident is publicly reported as caused by "bad track." A cow on the track, broken rail, misplaced switch, *anything* that can be plainly seen as the cause of a "run off" has a wonderful effect in brightening up the countenance of some of the "supers," but it is painful to watch the gloomy shadows as they settle over the official brow when one of them is informed that "it was bad track." Perhaps he will admit to a confidential friend that "it was all his fault. There was no such trouble when Jim was there, but now there is a train off every day. I missed it when I cut down his pay. I would have made money had I raised his salary and kept him." As the novel writers say: Remarks similar to the above might have been heard on more than one occasion by any one who would place an ear to the keyhole of the private office of a superintendent that I know of, and such a declaration would be very near the truth.

From what I have seen in the course of a recent short journey, I should say that the 37 unexplained derailments as published in your "train accidents in August" were the result of "letting Jim go." Of the 11 cases of cattle on track, probably nearly all that did not occur at crossings were due to that also. Three cases of spreading of track (two at switch), same cause; failure to flag when frog was removed, ditto. These would result from carelessness, willful neglect and ignorance. I believe that if some superintendents would paste the following in their hats, the number of unexplained derailments would be greatly reduced. "Mem.: To fill the ditches with wrecks, employ inexperienced track men because they are cheap."

WM. S. HUNTINGTON.

Change of Gauge of the Grand Trunk Railway.

[We are indebted to Mr. E. P. Hannaford, Engineer of this railroad, for the following description of the recent change of gauge on this line and the accompanying circulars, which show very clearly how the work was managed.]

The main line from Stratford, Ont., to Montreal, 421 miles, and including sidings 500 miles, took 1,510 men to do the work, averaging $3\frac{1}{2}$ men per mile of main line.

The Engineer laid out the work personally by going over the road by hand-car, arranging each gang in position and laying out the details of working.

To each 15 miles of main line an overseer was appointed, and these overseers reported progress to the Engineer.

Each gang of men had their allotted work, and when complete reported to their overseer.

After the passage of the last train, it took each overseer from $3\frac{1}{2}$ to 5 hours to narrow his district of 15 miles; so had the main line been clear of cars so that all the overseers could have commenced at the same time, a maximum of 6 hours would have completed the work of 500 miles of main line and sidings.

Some of the main line was taken possession of after Friday noon, 3d October, and the balance Saturday, 4th October at day break. The whole was complete and trains running on the afternoon (2 o'clock) of Saturday, 4th October.

NARROW GAUGE, STRATFORD TO MONTREAL—INSTRUCTIONS TO OVERSEERS AND FOREMEN.

All foremen will be under the overseers as per printed list and must carry out their orders.

Each section foreman will be responsible for the narrowing of his section and all trackmen must work to his orders.

All extra men furnished from east of Montreal will be distributed in lots by Mr. F. L. Williams, who will be provided by me with a list showing the number of men to be put off at each station where they will be met by the section foremen.

Mr. Michael Stephenson will distribute the men between Stratford and Toronto and Mr. Robert Fountain eastward from Toronto, meeting Mr. F. L. Williams.

Road-masters and others furnishing men must understand their men are under the control of these distributors, and that no men are to be appropriated otherwise than as the distributors may direct.

Arrangements are made for providing meals and accommodation for extra men from a distance. Overseers must collect all accounts, certify and send promptly to me at Montreal for payment. Any amounts paid by overseers must in all cases be accompanied by vouchers. Hand cars will be provided, but overseers can employ other means of transit that may offer so as to get speedily over their districts.

In cases where stringers are to be narrowed in, section foremen must see to the blocking being firm and the rods put in place; where new rods are not provided the old ones are to be made ready.

Each gang will be provided with a gauge of 4 ft. 8 in., and foremen must see that the track is narrowed correctly to gauge.

Carpenters in charge of a foreman will be placed at all large bridges, and will narrow the timbers. Care must be taken the timbers are bolted to each other and the ironwork. The section foreman to see the rails are narrowed and spiked.

Mr. Brydges' circular No. 183 gives instructions as to when the work of narrowing the main line can commence, but it will not be necessary for men to work at night excepting in cases of accidents.

Orders for meals at our refreshment rooms at Stratford, Toronto, Cobourg, Kingston, Prescott Junction, Cornwall, Richmond and Island Pond will be issued by overseers to their men returning home, these to be properly filled in and signed.

The meals for men going to the work will be arranged for by the distributors.

I have been from Stratford to Montreal by hand-car and ar-

ranged each gang in position, and the work must be carried out according to the instructions herewith. The main line and one crossing-siding at each station being first narrowed, all hands must assist in the station yard.

Men from a distance must keep their tools with them—none must be boxed up.

Overseers must report to me by telegraph to Toronto of progress, from time to time, and I shall address all messages to their respective headquarters.

It is intended to start engines and cars immediately the gauge is narrowed and pick up men for their homes. All are requested to lose no time in getting back to their regular work.

E. P. HANNAFORD, Engineer.

INSTRUCTIONS FOR WORKING THE MEN.

Each section (the average length of which is five miles) will have two gangs of about 8 men in each gang, and one of these gangs being placed at each end of the section, they will work toward the center of the section until they meet. Both of these gangs will then narrow the station yard, if any on the section.

In many cases where there is a large station yard, or more than one station yard on a section, a special gang in addition to the two gangs will be furnished.

The regular section foreman of the section will place a competent and trustworthy man in charge of one of his gangs, he having charge of the other gang, and, taking his narrow-gauge hand-car with him, he will, when both gangs meet, run his hand-car over the portion of his section narrowed by the other gang, to see the gauge is right and all is secure for the passage of trains.

When an extra gang foreman or a section foreman from a distance takes charge of a gang, it will not be necessary for the regular section foreman to go over the whole main line done by such foreman until a crossing siding of the station yard is narrowed.

Sectionmen must be particular to narrow the sidings to wood and water supplies early.

Section foremen must report progress by telegraph to their overseer.

Road-masters between Montreal and Stratford will see their different section foremen before changing the gauge, and again explain the method of working the above rules.

E. P. HANNAFORD, Engineer.

Accompanying these circulars was a sheet containing a table which gave in detail the location of men for narrowing the gauge. The first column of this table gave the number of the district (generally 15 miles long); the second, the name of the overseer of that district; the third, place of district headquarters; fourth, distance from Montreal of east and west ends of district; fifth, length of district; sixth, names of the section of each district (usually three or four); seventh, "remarks," of which there was this one, stating the limits of District 21 to be "from Don Bridge to Northern Railway Crossing."

Freight Charges.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In what is said below on this subject, the intention of the writer is not to enter upon a discussion of the entire question of railway charges, but only that part of it which has reference to the rates on westward-bound through freights. Upon this subject we wish to offer a few suggestions for the consideration, more particularly, of those who have in charge the fixing of rates; intending merely to submit principles upon which, in our opinion, rates should be based, and not a fully developed scheme.

It is well understood that present rates on westward-bound freights are calculated upon a *pro rata* charge per ton per mile, with Chicago as the basis, at a nominal distance of 963 miles from New York. For instance, the managers of the various railroad lines in convention say: "Our rates for the summer to Chicago shall be as follows: first class, \$1.00; second class, 90 cents; third class, 75 cents; fourth class, 60 cents; and special class, 45 cents per 100 lbs., and corresponding rates to other competing points." This is equivalent to saying that rates to Chicago, Cleveland, Sandusky, Columbus, Dayton, Cincinnati, Indianapolis, Vincennes, Terre Haute, Mattoon, Effingham, Sandoval, St. Louis, Cairo, Fort Wayne, Champaign, Springfield, Peoria, Milwaukee, Detroit and a host of other places, shall be \$0.02-08, .01-87, .01-56, .01-25, and .00-98 per ton per mile, on the respective classes over the several distances.

The mileage being already established, it is a very easy matter, of course, to determine the rates to any competing point. Distance to Chicago is calculated via New York Central & Hudson River, Great Western and Michigan Central railroads; to Milwaukee via Detroit & Milwaukee Railroad and Lake Michigan from Detroit; and to points in Southern Illinois and other Southwestern towns via New York Central & Hudson River and Lake Shore & Michigan Southern railroads, and thence via Toledo, Wabash & Western Railway and other direct lines. It will be observed that Western competing points are taken as a whole and set upon an equal footing, without reference to facilities possessed or amount of business transacted. The only qualification a town need have, in order to secure the benefit of these competing rates, is the possession of two or more roads by which it can be reached from the East. Its business may hardly pay the cost of maintaining station conveniences. It may receive or send away a fraction of a car-load per day. Or, like Chicago, it may represent a business equal to nearly fifty per cent. of the entire traffic. These facts have no influence upon the rate; mileage alone regulates that.

Now is this mileage system just in its operation? Is it not, rather, as the Vice-President of one of our trunk lines recently said, "the same as asking a dry goods man to sell at retail as cheap as he would at wholesale?" Or to put it in another form, is it not asking the wholesale purchaser to pay retail prices? It is pretty generally admitted that distance, merely, should not regulate rates of transportation. "It would seem to be obvious," says the New York *Nation* of July 3, "if it were not so evident that it is by no means obvious, that rates of freight do not depend on distance, but on the amount of business done in proportion to the expense of carriage. Between competing points, and to and from large cities, the large business makes the rates low; between other points the light business makes them high. To take distance as the *invariable standard* is to mistake the character of the

whole question." The enactors of the present law of "equality of freights," in the State of Illinois, have wholly ignored the fact that a railroad company can much better afford to transport a given quantity of freight, say one hundred tons, from New York to Detroit, than it can to divide the same into fractions and carry it to twenty different intervening points, relative distances and rates being considered. They have also overlooked the fact that, of two points of equal distance from the place of shipment, but differing in size, the one doing fifty times the amount of business of the other, with rates equal, there is more profit accruing to the railroad company on each particular ton of freight going to the larger place, than on that going to the smaller. These we consider the weak points in the movement against monopolies in Illinois, and, as well, in the present system of making rates on freights westward bound from the seaboard.

But, as we before remarked, it is much easier to discover evils than to correct them. We can point out the blemishes in the structure of another, but when we ourselves come to build, we find our own architecture the subject of as much unfavorable criticism as that of our neighbor. Like the reverent Irishman, we Americans, with a similar grain of egotism, are too often seen to lift our hats at the mention of our own names while to others we are sure to exhibit more bare "cheeks" than bald heads. This railroad question is not an easy problem to solve, and, while the desideratum has not yet been reached, the present systems represent the plans of men of no ordinary ability. For that reason, this cry of dissatisfaction, and, indeed, "stop thief," which we hear from one end of the country to the other, to the writer seems like a most glaring insult, for the reason that, in most instances, it comes from men who have never investigated the matter beyond the surface appearance. The citizen of an unimportant town learns by bitter experience that he does not enjoy all the advantages of a large city and competing point, and, by some species of circumlocution, arrives at the conclusion that the fault is in railroad monopoly. The Western farmer has a very large crop of corn, and, because he cannot ship it two or three thousand miles and make a good profit, he assumes that the proper rewards of his industry are prevented by railroads. It may be well to remark right here, for fear it may be thought that self-interest prompts these observations, that the writer has no interest on one side or the other, save that which every citizen ought to have; but he is an admirer of that rare jewel sometimes called consistency.

Competition is the regulator of business as well as its life. In trade this is so apparent that proof here is unnecessary. The purchaser, knowing its potency, offers all the encouragement at his command to bring it about, and uses every effort to continue it. The merchant, unenterprising and extortionate without it, is stirring and reasonable with it. That this principle is equally applicable to transportation is generally conceded. Examples of its favorable effect on rates are too apparent to require mention. And yet we see the majority of would-be correctors of railroad abuses looking to laws expressly intended to prevent it for a remedy of the present evils. And why is it? Most of the really enterprising cities and villages of the country, appreciating the importance of competition in the proper adjustment of rates, have provided themselves, at great outlay of effort and means, with the second and the third road, thereby, as they supposed, securing great advantages. How many and grievous are the burdens to-day resting upon the cities and villages of the West, high taxes will attest for many years to come. Citizens of less important and less enterprising places now come forward and demand equal advantages. Rates to and from their neighboring city or village are relatively lower than to their burgh. That is discrimination in earnest, they maintain, and they at once raise the cry for a change. Now we would ask, is not this all sophism? Is not a so-called "competing point" entitled, in accordance with the rules and usages of business, to better rates than a non-competing one, for the very reason that it has placed itself in a condition to practically command them?

We should not leave out of the count, however, the fact that there are grades of competition. When a town first becomes a competing point by reason of its second road, it should not at once vault to the importance of a great commercial center. The amount of its business should be considered, and the relative cost of conducting its freight transportation should have weight in determining charges.

We maintain that a system based upon these principles is the only just and true one. But to prepare a schedule of rates upon such a basis that will be just to all places is, of course, no easy task. The first obstacle which we meet is that which lies in the way of correctly estimating the amount of business done at each point. If the system should come to a practical test, however, the interested lines could furnish in detail the requisite figures; but in order to illustrate here approximately the effect on rates of the adoption of such a system, not having the precise data at our command, we must resort to a comparative statement of traffic. We apprehend that, in our Western States, at least, the population of particular towns represents, approximately, the amount of their business. Assuming this to be true, we have taken the census of 1870 as our guide, and from it have prepared the accompanying table, in which we include a majority of the Western competing points.* By dividing the sum of the population of the cities and villages named in the table by the number, which is eighty-four, we find that the average population is about 14,000. We therefore take a place of that size as a representative one, and to such points we have left rates unchanged. But, to points of less population, we have fixed upon the following ratio of increase; and, to points of greater population, upon the following ratio of decrease of rates:

To places of less population than 14,000, for every 1,000 or

* We found this table too bulky to print, and have selected from it about twenty towns which illustrate the principle, perhaps, as well as the whole table.—EDITOR RAILROAD GAZETTE.

fraction in excess of 500 below that number, one-half of one per cent. has been added to the usual rate.

To places with a population in excess of 14,000, for every additional 14,000, or fraction thereof in excess of 7,000, one per cent. has been deducted from the usual rate.

It will be observed that this takes away the ground for the objection that the companies cannot afford to reduce rates to the larger places, as it would be taking away from their total

receipts, which, they claim, are small enough at best; for, by the adoption of such a system as that here submitted, rates are so manipulated as to net very nearly or quite the same return.

These suggestions are offered in hope that they may help to unravel the knotty matter of freight charges; and if they do have such an effect, the writer will be satisfied. We invite a discussion of the merits of the plan (if it has any) and hope to see well-meant criticism of its weak points.

TABLE OF PROPOSED RATES TO COMPETING POINTS.

963 Miles.	Rate per ton per mile.	Distance																						
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
		Chicago	Cleveland	Cincinnati	Piqua	Toledo	Indianapolis	Peru, Ind.	Detroit	Jonesville	Kalamazoo	Joliet	Mattoon	Bloomington	Dunville	Urbana	Decatur	Pearl	Pekin	E. St. Louis, Alton	Cairo	Quincy	Milwaukee	
963	963	629	884	884	741	911	907	679	812	903	963	963	1,079	991	1,027	1,103	1,079	1,079	1,173	1,231	1,217	963	963	
1.75	03.63	1.84	1.07	1.39	1.67	1.34	1.63	1.73	1.17	1.56	1.67	1.75	1.85	1.96	1.88	1.96	2.07	1.94	2.04	2.22	2.33	2.17	1.68	
1.70	03.50	1.84	1.01	1.35	1.62	1.29	1.58	1.68	1.14	1.51	1.63	1.70	1.80	1.90	1.83	1.90	2.02	1.88	1.98	2.15	2.25	2.11	1.63	
1.65	03.43	1.84	1.02	1.30	1.57	1.26	1.53	1.63	1.10	1.47	1.58	1.65	1.75	1.85	1.78	1.85	1.96	1.83	1.92	2.09	2.19	2.05	1.58	
1.60	03.32	1.84	1.06	1.36	1.58	1.22	1.54	1.69	1.07	1.49	1.53	1.65	1.70	1.79	1.72	1.80	1.89	1.77	1.86	2.03	2.13	1.99	1.54	
1.55	03.23	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
1.50	03.12	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
1.45	03.01	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
1.40	02.90	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
1.35	02.80	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
1.30	02.70	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
1.25	02.59	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
1.20	02.49	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
1.15	02.39	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
1.10	02.28	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
1.05	02.18	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
1.00	02.08	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
95	01.97	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
90	01.87	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
85	01.77	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
80	01.66	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
75	01.56	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
70	01.45	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
65	01.35	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
60	01.25	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
55	01.14	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
50	01.04	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
45	00.94	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
40	00.83	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
35	00.73	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
30	00.63	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
25	00.53	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
20	00.43	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
15	00.33	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
10	00.23	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
5	00.13	1.84	1.02	1.28	1.54	1.20	1.51	1.59	1.04	1.39	1.46	1.60	1.64	1.74	1.66	1.73	1.84	1.72	1.81	1.97	2.06	1.93	1.49	
0	00.03	1.84																						



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PLANS FOR FIXING FREIGHT CHARGES.

We publish elsewhere a communication in which the writer proposes a new method of fixing freight charges to competing points, accompanied by a table which shows what the rates would be by his method from New York to some of the principal competing points. This table as we received it was calculated for no less than eighty-four different places, and evidently had received more labor than would have been given if the principle and its application had not been considered important. We have given only about one-fourth of the table, which is sufficient to illustrate the principle and the effect of carrying it out, and it will hardly be needed for anything more, we imagine.

The plan of fixing the tariffs is a very simple one, consisting of establishing a basis rate for an assumed place of 14,000 inhabitants at a distance of 963 miles from New York. The rate per ton per mile is found from this, whatever it may be, and the rate per ton per mile to any competing points is formed by increasing this basis rate half of 1 percent. for every 1,000 people and fraction of 1,000 greater than 500 less than 14,000 which the place may have, and by decreasing the basis rate 1 per cent. for every 14,000 inhabitants more than 14,000 which the place may have. Thus competing towns of less than 500 inhabitants (if there are any) would pay 7 per cent. more per ton per mile than towns of 14,000, and towns of 400,000 inhabitants would pay 28 per cent. less, and the difference in rates to towns of 500 and those of 400,000 inhabitants would be 48½ per cent. With \$1.00 as the basis rate, the rate to the place of 400,000 inhabitants would be 72 cents; to that of 500, \$1.07, and the difference would be 35 cents, which is 48½ per cent. of 72. Generally, the effect would be to make the rates higher to small places than to large ones, which, indeed, is stated to be the object of the plan.

The writer states two principles for fixing rates. One of these is to give more favorable rates to competing than to non-competing points; the other to reduce rates to places in proportion to the traffic of those places. (He uses the population instead of traffic in making up his table because the figures for traffic are not accessible.)

Now these principles, if they are made to embody causes, should be stated more fundamentally. When a new transportation route is opened to a place, its effect on the old route is to reduce the amount of its traffic, and this is its sole natural effect under ordinary circumstances, and is inevitable, without some radical change. We may therefore put the principles thus:

1. Competing points should have reduced rates, because they give less business.

2. Large places should have reduced rates, because they give more business.

The fact is, the giving of lower rates to competing points is not determined by the inherent justice of the claim, nor because it costs less to carry to such places. When a railroad which has had all the traffic between two places is suddenly confronted by a rival which those places have established wholly or in part, the old company is certainly not moved by gratitude, and no less certainly not by justice, to reduce its rates. Instead of costing it less, it costs it more to do the work, and the absolute cost to the two companies of carrying a given traffic between the two places is very much more than it would have been to one, had the competitor not been established. Nevertheless, it usually does reduce its rates, and frequently very largely, simply because it can get no business if it does not, and half of the old traffic at a quarter of the old profit is better than no profit at all. It is with the railroad as it is with most kinds of business: if it cannot get what it wants, and what would pay it a satisfactory profit, it will take what it can get, provided it pays some profit. Only, the railroad has pro-

vided a very costly machinery for doing the traffic between the two places which can be used for nothing else. Nothing can be made to take the place of the business which is lost. It is like a great hotel built at a once fashionable resort. The proprietor readily got 20 per cent. on its cost as rent in its palmy days. When guests withdrew and there was no longer a demand for its rooms, he was glad to let the rooms for tenements, for storing grain and for any purpose, and for rents which perhaps hardly paid the taxes. If there should ever be so strong a combination among the railroad companies as to enable them to fix their rates as nearly as possible according to cost, we may be sure that competing points would receive no favors because of being competing points.

It is true, however, that rates cannot be made (with the greatest advantage to the carriers and to all their customers) exactly in proportion to the cost of carriage. And this leads us to take exception to the differential basis, decreasing with the increase of population, proposed by our correspondent. It is true that his rates would not be in proportion to cost; but they are assumed to be so, approximately. If they were, however, they could not be maintained, not if all the railroad companies and all the legislators in the Union should agree upon them, without utterly putting an end to a large part of the existing traffic. Let us put side by side same of the proposed rates to principal towns (the basis being \$1.75 per hundred):

Chicago.....	\$1.38	Joliet.....	\$1.75
St. Louis.....	1.72	St. Louis.....	2.22
Milwaukee.....	1.68	Racine.....	1.78
Cincinnati.....	1.39	Columbus.....	1.39
Cleveland.....	1.07	Sandusky.....	1.26
Detroit.....	1.17	Jackson, Mich.....	1.48

In this table the places in the second column are either a little further from or a little nearer to New York than the places opposite in the first column. It is evident that there could hardly be any through shipments to those places named in the second column, with such a discrepancy of rates, and they certainly could not hope to compete with the others in trading with the surrounding country. East St. Louis (an extreme instance) would pay 50 cents per hundred more than St. Louis, which receives all its New York freight in East St. Louis depots and pays a very high price for ferrying it across. Milwaukee must cease to wholesale goods and go to Chicago to buy, and Chicago, indeed, would be the sole buying market for the country nearly as far east as Detroit, and to the west illimitably. The smaller towns would be entirely cut off from wholesaling, and their customers would not even have the choice between Chicago and New York, unless they took measures to have their goods re-shipped in Chicago.

To show the effects of such a tariff in Illinois, we have made the following table, in which the first column gives the rate per hundred pounds of first-class freight from Chicago to the town named according to the tariffs published by the Illinois Railroad Commissioners; the second, this rate plus our correspondent's rate from New York to Chicago when the basis rate (from New York to an imaginary point of 14,000 inhabitants 963 miles distant) is \$1.50— which is \$1.18; and the third the rate by his plan from New York to these towns with the same basis rate:

	FROM NEW YORK.	From Chicago. Via Chicago. By proposed plan.
Alton.....	63	\$1.81
Bloomington.....	42	1.60
Cairo.....	74	1.93
Champaign.....	43	1.61
Camp Point.....	60	1.78
Decatur.....	49	1.67
Edinburgh.....	54	1.72
East St. Louis.....	65	1.83
El Paso.....	45	1.63
Jacksonville.....	56	1.74
Jolie.....	25	1.43
Keokuk, Ia.....	61½	1.79½
Mattoon.....	50	1.68
Mattoon.....	23	1.40
Pana.....	54	1.72
Peoria.....	48	1.66
Pekin.....	49½	1.67½
Quincy.....	63	1.81
Sandoval.....	62½	1.80½
Springfield.....	53	1.70
Tolono.....	44½	1.62½
Urbana.....	49½	1.60½
Vandalia.....	50	1.77

We see here that when by our correspondent's plan the rate on first-class freight from New York to Chicago should be \$1.18, the two shipments from New York to Chicago and from Chicago to the interior competing point would cost less than a single through shipment to such point with every point in Illinois except Peoria alone, to which the rates would be the same by both methods. This means, of course, that the through shipments would be impossible. St. Louis itself would have its goods sent from New York to Chicago, and there have agents to reship them to their destination—if indeed it should have occasion longer to buy any goods to sell again. Even Cairo would save eight cents per hundred by this process.

We might go further and show that there are other mistaken assumptions in this plan of fixing rates. It is not true that the cost of transportation to any given place is in proportion to the amount of traffic carried to and from it. It is doubtless true that traffic can be handled

in large quantities cheaper than in very small ones, but a place of 40,000 inhabitants may handle it cheaper than one with twenty times the population and traffic. Freight is probably handled cheaper in Indianapolis to-day than in New York, and quite as cheaply perhaps as in Chicago. And it is quite possible that a place with very small traffic should be so situated as to present the conditions of carrying that traffic at the lowest possible cost. For it is not cost of handling alone or chiefly, nor the gross bulk of traffic even, which determines the average cost of conducting traffic to and from a given station. Most important of all is evenness of traffic, if we may call it so; that is, as nearly as possible full loads both ways for the trains which come to it, and full occupation for them at all times of the year. The town which sends traffic to New York but receives none, in fact uses the train for the whole round trip, and unless its traffic pays the cost of running in both directions, it is done at a loss. Simplicity of traffic has a great effect on cost. A place which ships nothing but coal, and just about so many car-loads daily, is a much better customer to the carrier than one which ships a little of everything, and wants twenty cars a day during the business season and half a one half of the rest of the time.

It is a wrong use of terms to speak of a city as a "wholesaler" in traffic. Cities are not customers for transportation any more than they are for goods. The people of a large city altogether need a great deal of transportation, and so they buy a great many goods. But there is no more reason that on this account the railroad company should give the Chicago or St. Louis man a low rate than that the New York merchant should sell his goods cheaper to a St. Louis or Chicago merchant than to one in Belleville or Joliet. The firm which ships large amounts is a wholesale buyer of transportation, as the firm which purchases large amounts of goods is a wholesale buyer of merchandise. Either can take advantage of their large purchase to get favorable rates, where there is any competition.

We have, perhaps, paid more attention to this subject than it really deserves; but the false assumptions and reasonings on this very important matter are so common and frequently so gross that an effort, at least, to correct some of them we believe to be justified. The plan above commented upon seems virtually a plan for destroying all through traffic except to large cities. The two principles of it we believe to be false and incompatible. And generally we may say that it is next to impossible that any system of rates based upon a single and simple principle should succeed—that is, it must result in the public disadvantage if adhered to. The general principle which is usually aimed at, in these easy methods of establishing rates, is to make charges always in the same proportion to the whole cost of transportation. But here the exceptional nature of a railroad destroys the justice and economy of such a rule, inasmuch as a railroad is a vehicle which almost always is, or at comparatively small cost can be made to be, capable of carrying much more than there is to be carried. Hence any traffic which the road can carry and which pays the smallest amount more than working expenses gives an addition to the net income, even if it does not pay its proportion of the interest on the capital invested. Hence we arrive at the principle that any addition to the traffic which pays more than working expenses is to be welcomed. It may not pay half the average rate of traffic, and may be such that if the rest of the traffic paid no higher rate the company would become bankrupt. And it is not competition alone which makes the acceptance of such rates advisable. The principle is general, and where a low rate, paying more than working expenses, will secure a traffic which cannot be got otherwise, it is justifiable, and advantageous to all the other customers of the carrier.

THE STANDARD CAR AXLE.

A writer in the last number of *The National Car Builder* makes some calculations regarding the first cost and the cost of hauling the extra weight of the standard axle adopted by the Car-Builders Association, compared with others of the old patterns which weigh 100 pounds less. He arrives at the conclusion, that if 1,000 cars are equipped with the standard axle, the extra expense in interest on first cost and expense of transporting the additional weight will amount in five years to \$382,400, or \$76,485 per annum. These amounts are so large that they will quite naturally attract considerable attention, and, if the calculations are correct, would be a good reason for rejecting the new axle. We will therefore analyze his calculations to see upon what ground they are based.

In the first place, we will say that the weight of the new axle, *finished*, will be only 300 pounds, and that the dead weight hauled is the difference between the weights of axles finished and not "rough." But dismissing that part of the question, we will compare the cost of trans-

RAILROAD EARNINGS FOR SEPTEMBER, 1873.

NAME OF ROAD.	Mileage.		Increase.		Earnings.		Inc.	Dec.	Per cent.	Earnings per mile.	
	1873.	1872.	Miles.	P. c.	1873.	1872.				1873.	1872.
Atlantic & Great Western	571	539	32	6	\$551,205	\$505,069	\$49,136	16,733	9%	\$771	\$637
Atlantic & Pacific	328	328			119,989	103,116	16,733	16,733	3%	360	314
Baltimore & Ohio	917	873	44	5	1,455,249	1,292,470	162,779	125,157	1,480		
Burlington, Cedar Rapids & Minnesota	334	261	73	28	144,901	113,834	31,067	27,324	4%	484	416
Central, of New Jersey	29	34			916,138	628,390	287,748	453,414	2,149		
Central Pacific	1,218	1,094	124	119	1,392,125	1,251,668	137,457	11	1,145	1,147	
Chicago & Northwestern	1,430	1,353	77	59	1,511,781	1,303,304	208,477	16	1,057	963	
Chicago, Danville & Vincennes	157	132	25	19	72,274	50,434	21,840	43%	460	382	
Cleveland, Cinc. & Indianapolis	470	470			489,139	417,327	14,812	14,812	3%	919	888
Erie	971	971			1,918,947	1,788,062	160,185	156,185	2%	1,977	1,811
Illinois Central	1,109	1,109			876,413	744,782	131,691	171,121	7%	790	672
Indiana, Bloomington & Western	344	212	132	614	168,453	124,203	44,250	35%	490	399	
Kansas Pacific	672	672			343,185	314,948	1,817	1,817	0%	519	509
Lake Shore & Michigan Southern	1,174	1,099	75	63	1,776,420	1,635,690	140,739	136,739	3%	1,514	1,484
Marietta & Cincinnati	284	284			208,514	191,41	11,613	11,613	6%	717	675
Milwaukee & St. Paul	1,236	1,121	115	104	1,193,209	811,961	381,248	47	965	733	
Missouri, Kansas & Texas	784	547	237	434	403,781	306,299	197,482	95%	515	377	
Mobile & Ohio	517	517			215,427	205,856		33,429	14%	417	415
Ohio & Mississippi	293	393			371,344	356,845	14,499	14,499	4%	945	908
Pacific, of Missouri	471	471			382,098	317,910	64,188	2	51	675	
St. Louis, Alton & Terre Haute, Main Line	264	266			126,258	138,556	12,298	8%	475	521	
Branches	71	71			52,44	38,570	18,474	31%	733	733	
St. Louis & Iron Mountain	2-9	258	31	12	311,027	191,001	117,026	62%	1,076	752	
St. Louis, Kansas City & Northern	583	583			286,248	232,819	53,424	33	491	399	
St. Louis & Southeastern	349	349			123,714	93,223	33,491	33,491	32%	355	267
Toledo, Peoria & Wausau	237	237			128,161	114,488	13,737	12	541	483	
Toledo, Wabash & Western	628	628			593,504	56,811	27,693	4%	945	901	
West Wisconsin	197	176	21	12	108,000	44,877	63,123	140%	548	255	
Total	16,291	15,305	986	61	\$16,180,443	\$13,881,394	\$2,396,776	\$47,727	5%	\$93	\$904
Total increase							2,349,019	17			

RAILROAD EARNINGS, NINE MONTHS ENDING SEPTEMBER 30.

NAME OF ROAD.	Mileage.		Increase.		Earnings.		Increase.	Decrease.	Per cent.	Earnings per Mile.					
	1873.	1872.	Miles.	P. c.	1873.	1872.				1873.	1872.	Inc.	Dec.	P. c.	
Atlantic & Great Western	543	539	4	0%	\$3,902,459	\$3,728,733	\$173,736		4%	\$7,187	\$6,918	\$269		3%	
Atlantic & Pacific	328	328			975,933	811,531	164,366	20%	2,975	2,474	501	20%			
Burlington, Cedar R. & Minn	334	261	73	28	893,675	691,152	133,523	21%	2,466	2,049	523	18%			
Central, of New Jersey	291	291			6,554,033	5,383,616	1,168,357	22%	29,516	18,501	4,015	21%			
Central Pacific	1,218	1,094	124	116	10,183,178	9,307,444	875,734	9%	8,301	5,595	2,706	17%			
Chicago & Northwestern	1,462	1,341	61	43%	10,034,533	8,910,948	1,123,581	13%	7,157	5,645	512	7%			
Chicago, Danville & Vincennes	137	132	5	4	501,441	449,236	52,209	11%	3,600	2,408	257	10%			
Clev. Col. Cinc. & Indianapolis	470	417	53	12%	3,611,164	3,274,471	336,593	10%	7,683	7,852	169	2%			
Erie	971	962	9	1	14,554,208	13,925,311	628,897	14%	9,929	9,475	514	3%			
Illinois Central	1,109	1,166	57	43%	993,113	150,307		5%	5,455	5,185	270	5%			
Indiana, Bloomington & W. N.	283	212	73	58%	2,645,948	2,664,858	\$18,910	15%	4,014	4,688	.....	674	42%	
Kansas Pacific	672	672			1,144,030			9%	3,937	3,966	168	2%			
Lake Shore & Mich. Southern	1,144	1,037	101	10%	14,626,60	12,744,926	1,851,664	14%	12,194	12,38	38	2%			
Marietta & Cincinnati	284	284			1,624,131	1,478,843	1,255,388	10%	5,754	4,961	793	16%			
Milwaukee & St. Paul	1,187	1,086	101	9%	6,413,010	7,792,503	1,628,810	33%	5,4	4	411	902	22%		
Missouri, Kansas & Texas	688	507	181	35%	2,473,618	1,238,415	1,234,802	99%	5,955	2,448	1,152	47%			
Mobile & Ohio	517	517			1,965,681	1,941,361	24,317	14%	3,802	3,157	47	14%			
Ohio & Mississippi	393	393			2,732,519	2,491,428	261,995	10%	7,04	6,339	665	10%			
Pacific, or Missouri	471	419	55	12%	2,703,988	2,563,485	140,433	5%	5,741	6,118	.....	377	6%	
St. L. Alt. & Terre Haute main line	266	266			1,056,287	1,027,116	28,971	2%	3,971	3,963	168	2%			
Branches	71	71			449,697	35,857	91,510	20%	6,334	5,112	1,322	36%			
St. Louis & Iron Mountain	289	238	51	21%	1,855,545	1,628,552	227,013	14	6,421	6,843	.....	422	6%	
St. Louis, Kan. City & Northern	5-3	583	.....		2,030,312	2,036,016	5,704	0%	3,483	3,49	.....	9	0%	
Toledo, Wabash & Western	628	628	.....		4,424,130	4,365,388	58,749	1%	7,045	6,951	94	1%		
Total	14,281	13,937	894	61%	\$103,374,088	\$92,523,601	\$10,875,096	\$34,614	5%	\$7,246	\$6,911	\$335	4%		
Total increase							10,550,482	11%							

porting axles weighing 260 pounds each finished with that of the standard axles which weigh 100 pounds more.

The writer in the *Car Builder* assumes that it costs 1½ cents per ton per mile to haul the extra weight of axles. Now, if it costs so much to haul a ton of wrought-iron, it must cost at the same rate to haul the cast-iron, wood, etc., of which the car is constructed, and the freight with which it is loaded.

Now it is a well-known fact that even on well-managed roads the proportion of dead weight of cars to paying weight of freight hauled will average about as 4 is to 3. The average weight of a train of say 25 freight cars would thus be as follows:

Engine and tender 100,000 lbs.
25 cars, 18,000 lbs. each 450,000 lbs.
Average load carried, 13,500 lbs. each 337,5-0 " 1 caboose car 20,000 "

Total 907,500 lbs.

At the rate of 1½ cents per ton per mile, it would cost \$5.67 to haul this train one mile, or, taking the distance from Chicago to New York at 963 miles, it would cost \$5,460.21 to haul this train through. Now the rate of freight is frequently as low as, and sometimes lower than, 50 cents per 100 lbs., at which rate the earnings of the above train would amount to \$1,687.50, so that the railroad companies, according to the writer in the *Car Builder*, must lose \$3,772.71 on each through freight train they run at these rates. His error is in assuming that it costs 1½ cents per ton per mile to haul the dead weight of cars. He forgot that in calculating the cost of carrying freight the cost of the dead weight is charged to the freight. If, for example, it should cost \$2.10 to haul the above train one mile, if we divide that cost by the number of tons of freight, we should have a cost of 1½ cents per ton per mile; but if we divided it by the total weight of train, we will find the cost per gross ton is only 0.46 cent per ton per mile—a very important difference. In calculating the cost of carrying freight, it is of course necessary to charge the cost of the dead weight to it, because it is impossible to carry the freight without the dead weight.

In the last report of the Lake Shore & Michigan Southern Railway it is estimated that the average cost of carrying a ton of freight per mile is 0.92 cent. This, of course, includes the cost of carrying the weight of cars and engine. According to these figures, then, the cost per mile of the train described above would be \$1.551,

which, divided by its total weight, would give a cost of 0.34 cent per gross ton of weight of train per mile. This would reduce the cost of hauling the axles calculated by the method of the *Car Builder's* correspondent from \$350,000 to \$35,025, or, including interest on first cost, from \$76,485 to \$27,525 per year.

Another though a minor cause of error in his calculations is that he makes no allowance for a difference in the value of the old material of the heavy and light axles. Old axles, which weigh 360 pounds when new, would certainly be worth more than those which weighed only 260 pounds each.

The greatest error, however, is that he allows no credits to the large axle. Now if he will refer to the last report of the Car-Builders Association, he will find that in some experiments made by Mr. Garey it was shown clearly that journal-bearings for 5x3½ inch journals lost 5 pounds in weight while running 28,000 miles, while 3¾x7 inch journals lost only 2½ pounds. The large bearing, therefore, lost 2½ pounds less in running that distance than the small one. In running 112,500 miles, which is the distance the correspondent referred to has assumed that cars would run in five years, the difference in loss of weight would be 11 pounds less for the large than for the small journal-bearing. For 1,000 cars this difference would amount in five years to 88,000 lbs. of brass, which at 40 cents per pound would amount to \$35,200. Besides, as Mr. Garey very forcibly said, "if we displace 5 pounds from the bearings in a journal 3½ by 5½, and only

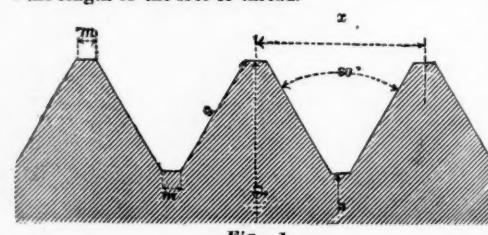
greater security from accidental injury which the round top possesses. Its objectionable features are, first, that the angle of 55 degrees is a difficult one to verify; it is probable no gauges to this angle, made independently of each other and without special tools, would correspond with sufficient accuracy. Secondly, the curve at the top and bottom of the thread of the screw will not fit the corresponding curve in the nut, and the wearing surface in the thread will be thus reduced to the straight sides merely.

"It is not to be inferred from this that these curves cannot be made to fit, but only that the difficulties in producing contact are so much increased by the peculiar form that in practice it will not be accomplished. Thirdly, the increased cost and complication of cutting tools required to form this kind of thread in a lathe, it being requisite that this tool shall have at least three cutting sides, in order to form the round top between two of them. The necessity of guarding the edge of the thread from accidental injury becomes more and more apparent as the size of the bolt is increased, and we have recognized this by finishing bolts with a small flat top upon the top of the thread. It being conceded that the flat, angular sides are necessary, we have only to choose between the rounded and flat top; and having examined the former, it only remains to notice whether the flat will be found free from the objections urged against the round. As the sides of the thread are the only parts requiring to be fitted, and as these are of the same shape as the sharp thread, the one will be as easily made as the other. The width of the flat top will be determined by the depth to which the thread is cut, so that the same tool can be used in both cases. The flat on the top of the thread being required to protect it from injury, it is evident that a similar shape at the bottom would give increased strength to the bolt, as well as improve its appearance. To give this form requires only that the point of the cutting tool shall be taken off, and then it is evident this thread can be cut in a lathe with the same tool and in the same manner as the sharp thread."

The rule given by Mr. Sellers for proportioning this thread is as follows: "Divide the pitch, or, what is the same thing, the side of the thread, into eight equal parts, take off one part from the top and fill in one part in the bottom of the thread, then the flat top and bottom will equal one-eighth of the pitch, the wearing surface will be three-quarters of the pitch, and the diameter of screw at bottom of the thread will be expressed by the formula:

$$\text{diameter} = \frac{1.299}{\text{no. threads per inch}}$$

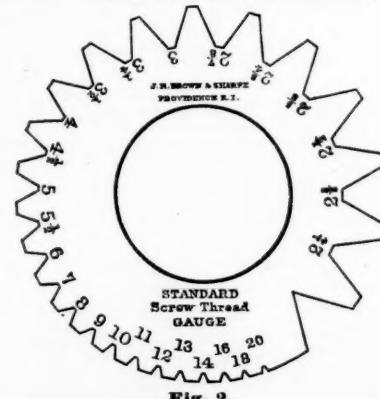
In order to make the form and proportions of this standard thread as plain as possible, we have had an enlarged diagram engraved, so as to represent the different parts clearly. x represents the pitch, d the diameter of the screw in inches, v the number of threads to the inch, n the diameter at bottom of thread, m the width of back part of thread at the top and bottom, and s the length of the side of thread.



From Mr. Sellers' rule the following formulae can be deduced:

$$\begin{aligned} n &= d - \frac{1.299}{v} \\ m &= \frac{x}{v} \\ s &= \frac{2x}{4} \end{aligned}$$

From this rule any thread can be constructed, it being



only necessary to know the number of threads to the

inch, which, in order to make this description complete, we give below:

Diameter of bolt.....	14	5-16	5	7-16	5	9-16	5	5	5	5	1
No. threads per inch.....	25	18	16	14	13	12	11	10	9	8	
Diameter of bolt.....	13	13	13	13	13	13	13	13	13	13	2
No. threads per inch.....	7	7	6	6	5	5	5	5	5	4	

For practical use Mr. Sellers has devised a very ingenious gauge, to which chasing tools can be fitted for any size of thread. This gauge gives the angle and also the amount to be taken off the point of the tool for any sized thread. For practical use, however we think that probably the gauge manufactured by the Brown & Sharpe Manufacturing Company, and shown in fig. 2, will be found the most convenient.

Wherever this standard thread is used, if any pretense at all is made to accuracy of workmanship, careful attention should be given to the form and proportion of the threads as well as to the number to the inch. In buying taps and dies the purchaser should see that they conform in every respect to the standard, and in making specifications for new work similar care should be exercised to secure the true standard, form and proportions of screws. In many shops the workmen who have the care of those tools are entirely ignorant of the peculiarities of the Sellers' system and have only the vague idea that so long as they get the proper number of threads to the inch they are doing all that is necessary to secure uniformity. Unless, therefore, some care is exercised to insure accuracy of workmanship in this department, the adoption of a "standard" for screws will not insure the advantages which would result from uniformity of screws and threads.

How Farmers May Control Railroads.

Farmers controlling railroads is by no means an absurd thing, and may frequently be a desirable thing; but an indispensable requisite to such control is, in our opinion, the possession of the majority of the stock. And this is not at all an impossible thing. The farmers could in no very long time buy the railroads which they use, or at least a controlling interest in them, which would enable them to dictate their management. Suppose, for instance, the people on the Chicago & Alton should desire to secure control of it. This control would be secured by holding more than \$5,677,750 of its stock, which is sold now at about par. The company works about 650 miles of road, so that we may say that the average amount per mile of road which it would be necessary to purchase would be \$8,750. Assuming that on an average the country for ten miles on each side of its lines used them, there would be 12,800 acres of land per mile tributary to the road, and the average expense per acre of securing the control of the company would be about 68 cents. Each owner of 150 acres would need to buy one share, and nearly all of them, doubtless, could do so within a year or two; while a great many could buy two or more. The Chicago, Burlington & Quincy, too, works a mile of road to about \$14,675 of stock, so that \$7,400 of stock per mile would control it. The last sales reported were at 90 or thereabouts, so that this amount could be secured for \$6,660, which is 52 cents per acre of land for ten miles on each side of the road.

The trouble with the farmers and other residents on these Western railroads, however, is that they can make greater profits, or think that they can, on their capital by using it in their business or in neighborhood investments than by investing in railroad stocks, even at the present shockingly low prices; which leads one to think that, such being the case, they should not be angry if the stockholders receive profits which are not satisfactory to farmers themselves.

But, seriously, it is on many accounts desirable that a large part of the stock of a railroad should be held by its customers. They would learn experimentally, and in a manner not likely to be forgotten, the rights of carriers, the difficulties of conducting railroad business, the desirability and justice of earning an income on railroad investments, and, we may say, the fact that railroad officers and managers are human beings, with some sense of justice, some public spirit and some human failings. Not uncommonly now they seem to look upon them as a new species of demons, with satanic cunning and greed and more than satanic power.

Record of New Railroad Construction.

This number of the RAILROAD GAZETTE has information of the laying of track on new railroads as follows:

Philadelphia & Reading.—The Perkiomen Branch has been extended from Green Lane northward 5 miles to Pennsburg, Pa. *Pittsburgh, Virginia & Charleston.*—Extended southward 16 miles up the Monongahela River to Monongahela City, Pa. *Green Bay & Minnesota.*—Extended southwestward 6 miles to Arcadia, Wis. *Kansas Pacific.*—The Arkansas Valley Branch has been extended southwestward 18 miles to Las Animas, Colorado. *Texas & Pacific.*—The Jefferson Division has been extended north by east 7 miles to Moore's Landing, 45 miles from Jefferson; the Transcontinental Division has been extended eastward 5 miles to Quinney, 34 miles east of Sherman, Texas. *Northern Pacific.*—The Pacific Division has been extended from Tenino, Wash. T., northward 23 miles. *Washington City, Virginia Midland & Great Southern.*—The Lynchburg & Danville Extension has been extended southward 17 miles to a point 24 miles south of Lynchburg, Va.

This is a total of 97 miles of new railroad, making a total of 2,867½ miles completed in the United States in 1873.

THE RAILWAY ASSOCIATION OF AMERICA met in Chicago on the 8th inst., having a small attendance. Mr. J. M. Walker,

President of the Chicago, Burlington & Quincy Company, presided in the absence of Mr. Thomas Allen, the President. A committee of three, with Mr. Robert Harris, Superintendent of the Chicago, Burlington & Quincy Company, as chairman, was appointed to report amendments to the constitution. A communication was received from the general ticket agents, regarding the abolition of the practice of paying commissions for selling tickets, the action on which we report elsewhere. Mr. Lyman Bridges, of Chicago, who has recently returned from Vienna, explained the signal systems used in Europe, and exhibited drawings of other railroad works. An adjournment was had until the 12th of November, when a special meeting will be held in Chicago.

Train Accidents in September.

On the morning of the 1st, near Bargetstown, Ohio, on the Pittsburgh, Cincinnati & St. Louis Railway, the four rear coaches (all sleeping cars) of an east-bound express train were thrown from the track by a broken rail, and three of them went into the ditch. One passenger was injured.

On the morning of the 1st, near Brookfield, Wis., on the Milwaukee & St. Paul Railway, twelve cars loaded with grain and flour of an east-bound freight train ran off the track and were considerably broken up, blocking the track several hours.

On the afternoon of the 1st, an extra freight train on the Chicago, Rock Island & Pacific Railroad ran off the track at a sharp curve between Utica and La Salle, Ill., where track-men had taken up a rail for repairs and neglected to put out flags. The locomotive and four cars were badly damaged.

On the morning of the 2d, near Port Byron Junction, Ill., on the Chicago, Rock Island & Pacific Railroad, five cars in the middle of a west-bound accommodation train were thrown from the track and ditched while passing around a curve.

On the 2d, a freight train on the Pittsburgh, Cincinnati & St. Louis Railway was ditched a little west of the line between Ohio and Indiana, blocking the road some time.

On the evening of the 2d, at Port Byron Junction, Ill., a north-bound accommodation train of the Western Union Railroad jumped the rails and threw five cars across both tracks, by which 18 trains on different roads were delayed until a track could be laid around the wreck.

A bout 4 o'clock in the morning on the 3d, a north-bound freight train on the Allegheny Valley Railroad ran into the rear of an express train which was standing on the main track at the Foxbury depot. The sleeping car at the end of the train was so driven into the end of the car ahead and so closed at the rear by the locomotive, which was pouring smoke into it, that the passengers had to get out through the windows. One passenger was considerably hurt. The freight seems to have been ahead of time, and its engineer ran away.

On the 3d, at Prairie Switch, Ind., on the Toledo, Wabash & Western Railway, section men having neglected to fasten properly a rail which had been taken out for repairs, twelve cars of a freight train were ditched and the road blocked three or four hours.

On the evening of the 3d several cars of a freight train on the Morris & Essex Division of the Delaware, Lackawanna & Western Railroad were thrown from the track at Milburn, N. J. Trains were delayed several hours, both tracks being obstructed.

On the night of the 3d, as a heavy freight train on the Pittsburgh, Fort Wayne & Chicago Railway was running around a curve in the city of Pittsburgh, it left the track and ran through a new brick building, wrecking several cars.

On the morning of the 4th, a local passenger train on the Baltimore & Potomac Railroad was passing through the tunnel under Madison street, in leaving Baltimore, it ran into a freight train which was standing on the track, killing a brakeman.

On the 4th, at Augusta, Mich., on the Michigan Central Railroad, the locomotive and several cars of a freight train were thrown from the track and wrecked by a misplaced switch, blocking the road until a track could be made around the wreck.

On the 4th, near Walpole, N. H., on the Cheshire Railroad, a part of the freight train broke loose and ran back, and another train met it, wrecking three cars and the locomotive.

On the 4th, 40 coal cars of a train on the Ithaca & Athens Railroad ran off the track, and a brakeman was killed.

On the night of the 4th, at Greenwood, N. J., on the Erie Railway, an extra west-bound freight train ran into the rear of a regular freight, breaking to pieces one car.

On the 5th, at Pomfret, Conn., on the New York & New England Railroad, a fast freight train pulled in two, and on the engineer's backing his train some time afterward to take them on again, the two sections ran together with such force as to telescope two cars and damage a great deal of freight.

On the morning of the 6th a coal train on the Philadelphia & Reading Railroad ran into the rear of another train in the Port Clinton Tunnel, breaking up several cars and blocking the tunnel. The dispatcher had ordered the second train forward before hearing whether the first had got through. He was choked a little by a train-mate and then ran away.

On the morning of the 6th, near Wilson, N. C., on the Wilmington & Weldon Railroad, a freight train ran off the track and five or six cars were broken up.

On the 6th there was a collision between two freight trains on the Pittsburgh, Cincinnati & St. Louis Railway, badly wrecking the locomotives.

On the 6th, a bridge broke under a coal train at Ithaca, N. Y., on the Ithaca & Athens Railroad, and a train of coal cars fell into the inlet.

On the morning of the 7th, at Montpelier, Vt., on the Vermont Central Railroad, a north-bound express train was thrown from the track by a misplaced switch, and much damage was done to cars.

Shortly after noon on the 7th, at a few miles west of Concord, Pa., on the Atlantic & Great Western Railroad, there was a collision between an east-bound switching-train, drawing oil cars, and a working-train going in the opposite direction, by which both engines were demolished, six cars of oil burned, a citizen riding on the oil train was killed, and its engineer injured. The engineer of the working-train had made special arrangements to meet the oil train at Concord, but forgot all about it.

On the afternoon of the 7th, an east-bound train on the Western Maryland Railroad, which was carrying a menagerie to Baltimore, had a sleeping car and one coach, and a freight car of animals thrown from the track by a land slide, injuring three of the passengers and delaying the train four hours.

On the 8th, near Seymour, Ind., on the Jeffersonville, Madison & Indianapolis Railroad, a cylinder-head of a passenger engine blew out, delaying the train two hours.

On the morning of the 9th, near Moundsville, W. Va., on the Baltimore & Ohio Railroad, an axle broke under a freight train, throwing several cars from the track and blocking the road several hours.

On the evening of the 9th, near Hamilton, Minn., on the St. Paul & Sioux City Railroad, as a north-bound train was passing with some flats loaded with old rails to be re-rolled, a short rail slid upon the track from one of the cars and ditched seven cars following. The road was blocked seven hours.

On the night of the 9th, near Agency, Iowa, on the Burlington & Missouri River Railroad, an extra freight train ran off the track and went into the ditch.

On the 10th, a mile and a half east of Concord, Va., on the

Atlantic, Mississippi & Ohio Railroad, an east-bound mail train ran into the rear of a construction train which was backing westward at the time, wrecking two cars of the latter train and blocking the road a few hours. The watch of the conductor of the construction train is said to have been one hour too slow. One passenger was injured.

On the 10th, a freight train jumped the track on the Cheshire Railroad, in New Hampshire, blocking the track some hours.

On the morning of the 11th, about two miles west of Plattsburgh, Mo., on the Southwestern Division of the Chicago, Rock Island & Pacific Railroad, an east-bound passenger train ran over a steer, which jumped upon the track suddenly from the bushes, by which the locomotive, baggage car and one coach were thrown down a high bank and completely wrecked, scalding to death the engineer, who stuck to his engine, and severely injuring the fireman. Four passengers were considerably injured.

On the morning of the 12th, danger signals having been ordered to prevent regular trains moving over the part of the New York Division of the Pennsylvania Railroad between the Jersey City depot and the Bergen Cut, in order to permit a train carrying workmen to cross the north-bound track and enter the south-bound, a New Jersey Midland train came in at great speed and struck the locomotive. Two workmen were injured, one of them fatally. It is said that some of the signalmen neglected to display danger signals as ordered.

On the night of the 12th, at Livermore, Pa., twelve miles east of Conemaugh, on the Pennsylvania Railroad, an east-bound freight backed into a siding between the two main tracks to permit an east-bound express to pass. A pushing engine then backed into the east end of the siding to take its place in front of the freight already there, and left the switch open so that a west-bound freight approaching ran into this siding and struck the pusher as it was backing, knocking it so far to one side that

The east-bound express, passing at this moment, had the side of one of its sleeping cars knocked in. The engineer and the pusher were killed. The engineer and fireman of the west-bound freight, the flagman of the express and a passenger in the sleeping car were injured.

At one o'clock in the morning on the 13th, two coaches and a sleeping car of a north-bound passenger train, on the Madison Division of the Chicago & Northwestern Railway, were thrown from the track by a broken rail and rolled down the bank. Two passengers were somewhat injured.

On the 13th, at Millstone Junction, N. J., on the New York Division of the Pennsylvania Railroad, there was a collision between an engine and a freight train, by which a train was delayed three hours and some damage done to both engines. On the evening of the 14th, at Patroon's Creek, near Albany, N. Y., on the Rensselaer & Saratoga Railroad, the locomotive of a south-bound passenger train was thrown from the track by a misplaced switch, ran over the ties till it came to a bridge, and then turned over and landed bottom up in the creek, followed by the baggage car, which stood nearly upon end, while the forward truck of a drawing-room car left the rails but remained on the road-bed. The fireman, who was oiling the engine, was killed, and the engineer and two other trainmen were slightly hurt. It is reported that the switchman (who was arrested) was drunk.

On the night of the 14th, a little west of Goshen, N. Y., on the Erie Railway, the flange of one of the truck wheels of the locomotive of an express train broke, and the engine and five cars went off the track, the engine going down the bank and getting badly broken. The engineer was badly hurt.

Before one o'clock in the morning on the 15th, at East Buffalo, N. Y., on the Lake Shore & Michigan Southern Railway, an east-bound train struck a switching engine, severely injuring a man on the switching engine and throwing several cars from the track. A misplaced switch is reported as the cause.

On the 15th, about three miles south of Jacksonville, Texas, on the International & Great Northern Railroad, a wild engine ran into a north-bound freight train which was backing towards it. A brakeman was badly hurt, and the damage to property is reported at \$5,000.

The afternoon of the 15th, brakeman jumped upon a locomotive on the Pennsylvania Railroad in the yard at Harrisburg and began to experiment with the throttle-valve. He succeeded in starting the engine, but could not stop it, and it ran into another engine at a little distance, damaging both materially. The brakeman ran away.

On the afternoon of the 15th, in the Hoboken yard of the Morris & Essex Division of the Delaware, Lackawanna & Western Railroad, two switching engines, one on the main track and one on a side track, and both running in the same direction, came into collision at the intersection of the tracks, throwing both engines from the track and one of them into the ditch, and badly damaging two passenger cars.

On the evening of the 15th, two miles west of Lowell, Mich., on the Detroit & Milwaukee Railroad, a west-bound mail train ran over two cattle which suddenly ran before the engine, by which the rear truck of the tender, the baggage car, two express cars and two immigrant cars were thrown from the track, killing two persons and wounding twelve.

On the evening of the 16th, a mile west of Fairmount, N. Y., on the Auburn Division of the New York Central & Hudson River Railroad, an east-bound express train ran over a large block of granite which had fallen from a working-train, tearing off the pilot, the ash-pan and other parts of the locomotive, and the brakes from nearly all the cars. The train was going about 35 miles an hour and struck the stone on a high embankment, but no part of it was thrown from the track.

On the night of the 16th, between Colliersville and Lafayette, Tenn., on the Memphis & Charleston Railroad, four cars of a west-bound freight train went into the ditch on their sides, blocking the road three or four hours.

Before three o'clock in the morning of the 17th, an east-bound express train on the Great Western Railway of Canada ran through an open switch at Stony Creek, four miles west of Hamilton, Ont., and the locomotive fell down the bank, killing the engineer and fireman. The switch had been left open by a west-bound train, and two of its brakemen, whose duty was to attend to it, were arrested.

On the evening of the 17th, five miles above Columbia, S. C., on the Charlotte, Columbia & Augusta Railroad, there was a collision between a south-bound passenger train and a north-bound paymaster's train, by which both locomotives and two express cars were broken up, and Mr. W. Elliott Orchard, the Paymaster, and another man were killed, and three persons were badly hurt.

On the morning of the 17th, there was a collision between a west-bound accommodation on the Erie Railway and a coal train on the Syracuse, Binghamton & New York at the crossing in Binghamton. A signal was up against the Erie train, but there was so dense a fog that it was not seen until the train was within four rods of the crossing.

On the 18th, near Tyrone, Pa., on the Pennsylvania Railroad, one west-bound express train (the "Cincinnati express train") ran into the rear of another (the "Southern express"), doing considerable damage to the locomotive of the former and the rear sleeping car of the latter, severely injuring the engineer and fireman of the Cincinnati express, and crushing the hand of a passenger.

On the evening of the 18th, the engine, tender and baggage car of a south-bound express train on the Kansas City, St. Joseph & Council Bluffs Railroad were thrown from the track and badly wrecked by running over cattle, and the conductor and fireman were injured.

On the morning of the 19th, at Miami, Mo., on the St. Louis,

Kansas City and Northern Railway, a passenger train ran into a number of box cars which had been permitted to stand on the main track, and these cars as well as the passenger engine were badly wrecked. The fireman was killed and the engineer seriously injured.

On the morning of the 19th, near the White River bridge at Indianapolis, on the Vandalia Line, a switching engine was ditched and the road blocked three hours.

On the morning of the 19th, the rear coach of an east-bound passenger train on the Indianapolis, Bloomington & Western Railway, was thrown from the track just out of Indianapolis.

On the 19th, an engine fell through a trestle on the Port Royal Railroad, in South Carolina.

On the 19th, on the Port Morris Branch of the New York & Harlem Railroad, as a train of freight cars was ascending a trestle-work at Port Morris, N. Y., the coupling broke between the cars and tender, and the former ran down the grade, and several ran off the track and were wrecked, severely injuring two brakemen.

On the 19th, eight miles below Millen, Ga., on the Central Railroad of Georgia, the locomotive and six cars of a down freight train ran off the track where a culvert had been washed out by a flood, and the engineer, fireman, and another trainman were killed.

On the 19th, at Branchville, S. C., on the South Carolina Railroad, the engine of an up passenger train ran into a channel where a culvert had been washed out by a sudden flood, killing the engineer and three other trainmen.

On the morning of the 20th, between Portage and Wyocena, Wis., on the La Crosse Division of the Milwaukee & St. Paul Railway, an extra freight train ran into the rear part of a regular freight, which had broken loose and was standing upon the track, wrecking 12 cars and injuring fatally the conductor of the regular train.

On the morning of the 20th, at Port Henry, N. Y., on the Adirondack County Railroad, the locomotive of a mail train was thrown from the track by a defective switch, and the train delayed nearly seven hours.

On the morning of the 20th, at Mendota, Minn., on the Milwaukee & St. Paul Railway, an engine drawing one car ran into the rear of a freight train, breaking up six cars.

On the morning of the 20th, near Elizabethport, N. J., on the Central Railroad of New Jersey, a switching train of freight cars ran over a cow, and two cars were thrown over and broken to pieces, while three went over the bank. A man had his arm broken.

On the 20th, at West Farum, Quebec, on the Northern Division of the Vermont Central Railroad, a freight train ran through an open switch and into an engine house, driving an engine through the wall of that building.

In the afternoon of the 20th, at Jacksonville, Ill., there was a collision between a north-bound stock train of about 18 cars on the Chicago & Alton road, and a west-bound freight of 22 cars on the Toledo, Wabash & Western. The pilots of the engines struck, and the Chicago & Alton engine was turned over upon the depot platform. The safety valve blew out and the depot waiting-room was filled with steam and hot water. The track of both roads was blocked three hours.

On the morning of the 21st, near Great Bend, Pa., on the Erie Railway, the boiler of a locomotive exploded while running, injuring no one, though there were four men on the engine.

On the 21st, in Buffalo, N. Y., four cars of stock were thrown from the track by a defective frog.

On the morning of the 22d, as an east-bound freight train of about 90 cars was approaching Kingston, Pa., on the Cumberland Valley Railroad, it broke in two. The accident was not discovered, and the forward section was slowed while coming down a steep grade into Kingston. Then the rear section ran into it, wrecking 15 cars and killing a man who was sleeping in one of the cars, of which he had charge.

About noon on the 23d, near Kilbourne, Ia., on the Des Moines Valley Railroad, there was a collision between up and down freight trains on a bridge. The train men saved themselves by jumping. The engines and several cars were injured, and one of the former was thrown from the track, but nothing went over the bridge.

On the evening of the 23d, a south-bound train on the Indianapolis, Cincinnati & Lafayette Railroad jumped the track near the Indianapolis depot, causing considerable delay.

On the evening of the 23d, at Chana, Ill., on the Chicago & Iowa Railroad, the locomotive of a freight train was thrown from the track by a misplaced switch, and the engineer was caught between the engine and tender and killed.

On the morning of the 24th, an east-bound passenger train ran into a west-bound freight train as it was backing into a siding at Huntington, Ind., on the Toledo, Wabash & Western Railway, damaging both engines considerably.

On the 24th, at Maumee City, O., on the Toledo, Wabash & Western Railway, there was a collision between two freight trains.

On the 24th, at Wabash, Ind., on the Toledo, Wabash & Western Railway, a train was thrown from the track by a misplaced switch.

On the 24th, a north-bound freight train on the Washington City, Virginia Midland & Great Southern Railroad ran into some cattle near Fairfax, Va., by which the locomotive and two cars were thrown from the track, the former turning over and going down the bank.

On the evening of the 24th, near Frankford, Pa., on the New York Division of the Pennsylvania Railroad, a north-bound passenger train struck the end of a train which protruded slightly from a siding upon the main track.

On the night of the 24th, near Melrose, N. Y., on the Troy & Boston Railroad, a south-bound express train ran at speed into the locomotive of a freight train which, being more than one hour behind time, had run into a siding, so as to leave part of the engine on the main track. Both engines were badly damaged, and the conductor and baggageman of the passenger train and two passengers were injured. It is reported that the freight train could not be pushed far enough back into the siding, and that it had sent forward a flag, which, however, was not seen.

On the morning of the 25th, on the New Jersey Midland Railroad, a train was thrown from the track by a misplaced switch as it was entering the Jersey City depot.

On the morning of the 25th, a switching engine on the Pennsylvania Railroad pushed some cars upon a horse and cart at a crossing in Harrisburg, by which several cars were thrown from the track.

On the 25th, near Hastings, Mich., on the Grand River Valley Division of the Michigan Central Railroad, a west-bound mail train ran over a flock of sheep, killing eleven sheep and throwing the engine from the track.

On the 25th, near Fairhaven, Vt., on the Rensselaer & Saratoga Railroad, there was a collision between an extra freight and a gravel train.

On the evening of the 25th, at Havana, N. Y., on the Northern Central Railroad, a north-bound express train was thrown from the track by a misplaced switch, which the switchman had locked wrong.

On the evening of the 25th, near East St. Louis, Ill., the engine of a train on the Toledo, Wabash & Western Railway jumped the track, slightly injuring the conductor and a brakeman and delaying the train five hours.

About one o'clock on the morning of the 26th, near Hohokus, N. J., on the Erie Railway, a coal train ran off the track and blocked both tracks for some hours.

On the morning of the 26th, near Millbrook, Ill., on the Fox River Branch of the Chicago, Burlington & Quincy Railroad, a

freight train broke into two near the summit of a grade, and when the sections were some distance apart the rear cars ran down the grade with such velocity that they struck the rear of the front section and threw several cars from the track, blocking the road an hour and a half.

On the morning of the 26th, just south of New Durham, N. J., on the New Jersey Midland Railroad, there was a collision between a down passenger and an up freight, badly wrecking both engines and throwing several cars off the track, and blocking the road seven hours. The fireman of the freight, the head brakeman of the passenger train and one passenger were injured fatally, and the engineer of the freight dangerously, and eight passengers, the engineer and baggageman of the passenger train were slightly injured. The damage to property is estimated at \$18,000. The freight train had run eight minutes into the time of the passenger, which the conductor explained by the fact that his watch was eight minutes slow; but he was told at the last station he passed that he could not reach the next station until after the passenger was due to leave it.

On the 26th, near Colona, Ill., on the Rockford, Rock Island & St. Louis Railroad, there was a collision by which three locomotives were badly wrecked.

On the morning of the 26th, on the Morris & Essex Division of the Delaware, Lackawanna & Western Railroad, a driving wheel under the locomotive of an east-bound passenger train broke near Summit, N. J., delaying trains somewhat, but doing no serious damage.

On the 26th, a locomotive moving backward and pulling a construction train on the Mississippi Central Railroad Extension ran over a cow near the crossing of the Paducah & Memphis road, by which the locomotive, tender and four flats were thrown from the track, fatally injuring a man who was riding on the pilot of the locomotive.

On the afternoon of the 26th, near Colfax, Iowa, on the Chicago, Rock Island & Pacific Railroad, as a west-bound passenger train was rounding a curve, while running at a high rate of speed, an axle broke under the tender, throwing the tender and one truck of one coach from the track, in which condition they were dragged about half a mile.

On the night of the 26th, a truck broke under a car of a freight train on the Missouri Pacific Railroad, near St. Paul, Mo., and 14 cars were thrown from the track and the rails and ties torn up for 50 yards. The road was blocked five hours.

On the night of the 26th, at Adams, Ind., on the Indianapolis, Cincinnati & Lafayette Railroad, nine cars of a freight train were thrown from the track, blocking the road six hours.

On the 26th, near midnight, a west-bound passenger train on the Austin Branch of the Houston & Texas Central Railroad ran into the rear of a wood train which had come to a halt on the track, near Burton, Tex., and had failed to send back a flag. Four cars of this train were telescoped and the passenger engine thrown from the track, and its engineer injured.

Shortly after midnight in the morning of the 27th, at Plainsboro, N. J., on the New York Division of the Pennsylvania Railroad, a north-bound freight train ran into the rear of another north-bound freight which was waiting to put on more cars, injuring an engineer and a brakeman. The waiting train is said to have had no flag out, and the other had been ordered forward by telegraph.

On the morning of the 27th, four miles west of Topeka, Kansas, on the Atchison, Topeka & Santa Fe Railroad, as several freight trains were running with short intervals between them, a coupling broke in the middle of one train. A signal was sent back to stop the following trains and succeeded with the first of them; but the second one could not be stopped in time and ran into and broke in pieces the caboose of the train ahead of it, while its own engine was thrown from the track and badly damaged.

On the 27th, near Otsego, Wis., on the La Crosse Division of Milwaukee & St. Paul Railway, sixteen cars of a west-bound freight train ran into the ditch, injuring the conductor fatally and a brakeman severely, and blocking the road for four hours.

On the afternoon of the 27th, near Philadelphia, Pa., on the Philadelphia & Reading Railroad, there was a collision between two coal trains, by which one locomotive and six cars were badly wrecked and the track torn up. The road was blocked about three hours.

On the evening of the 27th, a freight train was wrecked on the Pennsylvania Railroad, near Columbia, Pa., blocking the road about an hour.

On the morning of the 28th, near Bolivar, Pa., on the Pennsylvania Railroad, an east-bound passenger train ran into two or three freight cars which had broken loose from a preceding freight train and run back several miles. The engine and first three cars of the passenger train were considerably damaged, and a man who was stealing a ride between two express cars was killed.

On the afternoon of the 28th, at Yolo, Cal., on the California Pacific Railroad, an engine engaged in making up a train struck the track and ran off, delaying the train two hours.

On the night of the 28th, on the Lehigh Valley Railroad, five cars broke from a freight train at Summit, Pa., ran back 20 miles to Penn Haven, and there jumped the track and were completely wrecked.

On the morning of the 29th, near Lawrence, Kansas, on the Kansas Pacific Railway, ten cars of stock ran off the track, blocking the road for some time.

On the 29th, near Griggsville, Ill., on the Toledo, Wabash & Western Railway, a broken wheel caused the caboose car of a freight train to run off the track and turn over, injuring the conductor and two stock men.

On the 29th, 1½ miles west of Rocklin, California, on the Central Pacific Railroad, a freight train ran off the track, and several cars were broken up.

On the afternoon of the 29th, in Buffalo, N. Y., on the Erie Railway, a freight car ran off the track, splitting a tie, and throwing a splinter with such force as to injure an employee severely.

On the afternoon of the 29th, at Castleton, Vt., on the Rensselaer & Saratoga Railroad, a south-bound passenger train ran into a freight train which was entering a siding. It is reported that if the engineer of the freight train had not jumped he could have backed his train enough to avoid the collision.

On the 30th, just west of the Bergen Tunnel, N. J., a train ran off the track on some trestle-work, on the New Jersey Midland.

About the middle of the month, at the Summit Station of the Mount Washington Railroad, a freight car broke loose and ran down the whole length of the road, making the distance of four miles in two minutes, it is said. Some one seeing it switched it off at the bottom, so that no damage was done except to the car.

Near the end of the month, as a freight train on the Burlington & Southwestern Railroad was crossing the bridge near the Chariton River, six miles west of Moulton, Iowa, a flat car jumped from the rails and caught on the bridge, throwing three other flats and the caboose into the river, badly breaking the bridge, and injuring a man who was riding in the caboose.

These accidents may be classified as follows, according to their nature or causes:

COLLISIONS.	21
Rail collisions.....	21
Butting collisions.....	8
Crossing collisions.....	7
Unexplained.....	4-40
DERAILMENTS.	
Unexplained.....	91
Misplaced switch.....	8
Cattle on track.....	8

Runaway trains	3
Breaking of bridge or trestle	2
Road washed away	2
Breaking of rails	2
Breaking of axles	2
Rail left unfastened	1
Rail removed and not flagged	1
Defective switch	1
Defective frog	1
Spreading of rails	1
Fallen load	1
Broken truck	1
Broken wheel	1
Broken flange	1
Land slide	1
Boiler explosion	1
Cylinder head blown out	1
Breaking of driving wheel	1
Train strikes derailed engine from opposite track	1
Striking fallen load	1
Total	106

Five of the rear collisions, two of the butting collisions and two of the derailments were caused by trains breaking in two, and in six of these cases the running away of cars broken off caused or aggravated the accident. Thus nine of the accidents were due to the failure of couplings. Besides the eight derailments, three collisions were due to misplaced switches. Two collisions and one derailment were occasioned by neglecting to flag trains when the track was temporarily obstructed.

Twelve of the accidents can be traced to defects or failures of the permanent way, and seventeen to defects or failures of rolling stock. Doubtless a very large number of the unexplained derailments, and a much greater number of which we hear nothing, were caused by defective track.

Of the 106 accidents here chronicled, twenty caused death and twenty others less serious injuries, so that sixty-six caused no noticeable personal injury. The total killed was 29 and injured 75.

For the twelve months ending with September our record stands as follows:

Month.	Accidents.	Killed.	Injured.
October.	90	29	102
November.	103	37	114
December.	112	42	133
January.	178	40	199
February.	133	25	126
March.	112	18	93
April.	101	23	88
May.	79	10	113
June.	90	12	104
July.	90	18	50
August.	150	63	155
September.	106	29	75
Total.	1,344	346	1,381

Last year we reported for September 71 accidents, which killed 24 and injured 104 persons.

The great decrease in the number of accidents and of fatalities, in comparison with August, is very striking. The total movement of trains was doubtless very much greater in September than in August, but the movement of passengers somewhat less, perhaps.

The average number of accidents per day, according to our reports since the beginning of the calendar year has been: January, 5.74; February, 4.75; March, 3.61; April, 3.37; May, 2.55; June, 3; July, 2.93; August, 4.84; September, 3.53; for the nine months, 3.81.

The season of derailments caused by running over cattle has nearly closed, and shortly we will have to chronicle greatly increased numbers of broken rails and their consequences.

Modern Steel.

At the recent meeting of the British Association in Bradford, England, Mr. W. H. Barlow, C. E., F. R. S., President of the Mechanical Section, delivered the following opening address before that section. We omit two introductory paragraphs:

In the observations which I have to address to you I shall not attempt a general survey of a subject so vast and so varied as the manufactures of this country, nor shall I attempt to describe the many new and beautiful inventions and mechanical appliances which form a distinguishing feature of the age in which we live; but I shall endeavor to draw your attention to one of the new materials—namely, modern steel—a material which, though of comparatively recent origin, has already become an important industry, and whose influence in the future seems destined to vie in importance with that resulting from the introduction of iron. I have used the term "modern steel" because, although the great movement in simplifying and cheapening the process of producing steel is necessarily associated with the name of Mr. Bessemer, yet we have further important steps taken in a forward direction as to the production and treatment of steel by Dr. Siemens and Sir Jos. Whitworth and others, both in this country and abroad. It is now seventeen years since Mr. Bessemer read a paper at the meeting of the British Association at Cheltenham, which was entitled, "On the Manufacture of Iron and Steel without Fuel." Not long afterward I attended one of the early experiments made by Mr. Bessemer in London. On that occasion most of those who were favored with an invitation to be present saw for the first time that wonderful process in which, by the simple aid of a blast of atmospheric air and the addition of a little manganese, a cauldron of melted cast iron was, in the space of some twenty minutes, converted into a material which approached wrought iron in so far that it was malleable, but differed from it in other ways, the precise character and quality of the material produced being at that time not fully known. I was kindly permitted by Mr. Bessemer to take away with me one of the small ingots cast on that occasion, and had it made into a bar in the workshops of the Midland Railway at Derby with the object of testing its strength. Just as the bar was finished it broke under the hammer, and an attempt to weld it together again, treating the metal as iron, failed. This led to the consultation among the smiths who had assembled round this mysterious bar, and, after some further trials, the metal was unanimously pronounced to be steel. Among those who attended that experiment at Mr. Bessemer's works there were not wanting some of that class who, though they admitted the genius and intelligence which devised the process, and expressed their admiration of it as a scientific curiosity, were nevertheless very incredulous as to its ever becoming practically useful; and it was not without much labor and skill in surmounting the difficulties of the case, indomitable perseverance in overcoming rooted prejudices, and great courage in undertaking the necessary expenditure, that Mr. Bessemer succeeded in producing that most valuable new material now known as "Bessemer steel."

It is satisfactory to know that Mr. Bessemer has often expressed his firm conviction that had it not been for the pub-

licity given to his invention through the paper which he read before the Mechanical Section of the British Association in 1856, and the great moral support afforded him by men of science whose attention was thereby directed to it, he believes that he would not have succeeded in overcoming the strong opposition with which his invention was met in other quarters. About this time, or perhaps a little later, a material was produced called "puddled steel," and about the same time the metal known as "homogeneous iron." The movement which had begun in the production of cheap steel was further assisted and developed by the regenerative furnace of Dr. Siemens, by the introduction of the Siemens-Martin process of making steel, and further and most important progress is suggested by the recent process introduced by Dr. Siemens making steel direct from the ore. According to the returns published by the jury of the International Exhibition of 1852, the total annual product of steel in Great Britain at that time was 50,000 tons. At the present time there are more than 500,000 tons made by the Bessemer process alone, added to which Messrs. Siemens' works at Landau produce 200,000 tons, besides further quantities which are made by his process at Messrs. Vickers', Messrs. Cammells', the Dowlais and other works.

I shall not, however, detain you by attempting to trace up the history and progress of steel, nor attempt to notice the various steps by which this branch of industry has been brought to its present important position. My object is to draw attention to this material as to its use and application for structural and engineering purposes. The steel produced by the Bessemer process was at a very early stage employed in rails and wheel-tires. In both these applications the object sought was endurance to resist the effects of wear, and toughness to prevent fracture by blows. There does not exist at present sufficient information to determine accurately the relative values of steel and iron when used for these purposes. As used for wheel tires steel had to compete with iron of the highest quality, but it is nevertheless introduced on most of our railways. The iron used in rails was not of such high quality, and the difference in duration shows a very marked advantage in the employment of steel, the duration of steel rails being variously estimated at from three to six times that of iron.

Steel is also extensively used for ship's plates, and by the War Department for lining the interior of the heaviest guns; while Sir Joseph Whitworth and Messrs. Krupp make guns entirely of steel, though for these purposes the metal is of different quality and differently treated, in order to withstand the enormous concussions to which it is subjected. And further, we have steel used in railway axles, crank axles for engines, in boilers, in piston rods, in carriage springs, and for many other purposes. But notwithstanding these various employments of steel, there has been, and there continues to be, a difficulty in applying it to engineering structures in this country. The want of knowledge of the physical properties of steel having been the subject of remark at a discussion at the Institution of Civil Engineers in 1852, a committee, composed of Mr. Fowler, Mr. Scott Russell, Captain Galton, Mr. Berkley and myself undertook to conduct a series of experiments upon this subject. Our services were of course rendered gratuitously, but the expenses of carrying out this inquiry and the samples of steel to be tested were liberally furnished by the firms of Messrs. Bessemer, Messrs. Jno. Brown & Co., the Barrow Hamitic Company, the Bolton Iron Company, Messrs. Cammell & Co., Messrs. Lloyds, Fosters & Co., the Newark Bridge Company, Messrs. Naylor, Vickers & Co., Messrs. Thurton & Sons, Messrs. Firth & Sons and Messrs. Siemens. The experiments recorded consist of four series. The first were made for the committee by Mr. Kirkaldy with his testing machine in London, and were chiefly directed to ascertain the relation which subsists between the resistances of tension, compression, torsion and transverse strain. In this series of experiments twenty-nine bars, 15 feet long, were used, each bar being cut into lengths and turned or planed into suitable forms for the respective tests, so that a portion of each bar was subjected to each of the above-mentioned tests. The tensile resistance varied in the different qualities of steel from 28 to 48 tons per inch, and the experiments established conclusively that the relation subsisting between the several resistances of tension, compression and transverse strains is throughout practically the same as in wrought iron; that is to say, that a bar of steel whose tensile strength is 50 per cent. above that of wrought iron will exhibit about the same relative increase of resistance under the other tests. They further showed that the limit of elasticity in steel is, like that of wrought iron, rather more than half its ultimate resistance. The total elongation under tensile strain, and the evidences of malleability and toughness, will be referred to hereafter. The second series recorded in the book published by the committee gave the results of tempering steel in oil and water. They were made by the officers of the gun factory at the Royal Arsenal at Woolwich, and show a remarkable increase of strength obtained by this process. This property of steel is now fully recognized and made use of in the steel which forms the lining of the largest guns. The third series of experiments was made by the committee upon bars 14 feet long, 1½ inch in diameter, with the skin upon the metal as it came from the rolls. The object of these experiments was specially directed to ascertain the modulus of elasticity. They were made with the testing machine at H. M. Dockyard at Woolwich, which machine was placed at our disposal by the Admiralty. The bars were obtained, with some exceptions, in sets of six from each maker, three bars of each set being used in tension and three in compression. Bars of iron of like dimensions were also tested in the same way, in order to obtain the relative effects in steel and iron. In these experiments 67 steel bars were tested whose tensile strength varied from 32 to 53 tons per inch, and 24 iron bars varying from 22 to 29 tons per inch.

The amount of the extensions and compressions were ascertained by direct measurement, verniers being for this purpose attached to the bar itself, 10 feet apart, so that the readings gave the absolute extensions and compressions of this length of the bar.

These experiments, which were very accurately made, showed that the extension and compression of steel per ton per inch was a little less than wrought iron, that the extension and compression were very nearly equal to each other, and that the modulus of elasticity of steel may be taken at 30,000,000, which result agrees with the conclusions arrived at by American engineers on this subject. This property of the metal is important in two respects. First, because inasmuch as the extension per ton per inch is practically equal to the compression, it follows that the neutral axis of a structure of steel, strained transversely, will be in the center of gravity of its section, and that the proper proportion to give to the upper and lower flanges of a girder, when made of the same quality of steel throughout, will be the same as in wrought iron. Secondly, because the modulus of elasticity of steel is practically equal to that of wrought iron, and the limit of elasticity is greater, it follows that in a girder of the same proportions as wrought iron, and strained with an equal proportion of its ultimate tensile strength, the deflection will be greater in the steel than in the iron girder, in the ratio of the strength of the metals; so that if it is necessary to make a steel girder for a given span deflected under its load the same amount as an iron girder of the same span, the steel girder must be made of greater depth.

The fourth series of experiments were made by the committee on riveted steel, and show clearly that the same rules which apply to the riveting of iron apply equally to steel; that is to say, that the total shearing area of the rivets must be the same, or rather must not be less, than the sectional area of the

bar riveted. Having thus obtained a knowledge of the behavior of steel under different strains, we may trace in what manner its employment would operate on the weight of metal required for large engineering structures. But before doing so I would call your attention to the question of the absolute tensile strength. Taking Mr. Kirkaldy's experiments in conjunction with those made by the committee, there is a greater range of strength exhibited, commencing as low as that of the best iron, and extending to above 53 tons per ton per inch. This great range of strength is due to the different qualities and make of the steel tested, and must not be mistaken for irregularity of strength in the manufacture; on the contrary, in the experiments made by the committee, in which three bars of each make were broken, the strengths, with the exception of one set, are as uniform as in the iron bars similarly tested. It is also to be observed that in applying steel to engineering structures we may dismiss from consideration those superior qualities which are of high price and made in comparatively small quantities. I propose, therefore, to confine my observations to the mild steels, such as are made by the "Bessemer," the "Siemens-Martin," and other processes having a tensile strength varying from 33 to 36 tons per inch, a material which is made in large quantities and at moderate cost.

Following the same rule as is adopted for wrought-iron (namely, that the maximum strain on the metal shall not exceed one-fourth of the breaking weight), we may consider steel of this quality capable of bearing at least eight tons per inch, instead of the five tons per inch estimated for like purposes in iron. We know from established mechanical laws that the limiting spans of structures vary directly as the strength of the material employed in their construction, when the proportion of depth to span and all other circumstances remain the same. We know also that, taking an ordinary form of open wrought-iron detached girder (as, for example, when the depth is one-fourteenth of a span), the limiting span in iron, with a strain of five tons to the inch upon the metal, is about 600 feet; and it follows that a steel girder of like proportions, capable of bearing eight tons to the inch, would have theoretically a limiting span of 960 feet. This theoretical limiting span of 960 feet would, however, be reduced by some practical considerations connected with the minimum thickness of metal employed in certain parts, and it would, in effect, become about 900 feet for a girder of the before-mentioned construction and proportions.

The knowledge of the limiting span of a structure, as has been explained elsewhere, enables us to estimate very quickly, and with close approximation to the truth, the weight of girders required to carry given loads over given spans; and although the limiting spans vary with every form of structure, we can obtain an idea of the effect of introducing steel by the relative weights of steel and iron required in girders of the kind above mentioned. Assuming a load in addition to the weight of the girder of one ton to the foot, the relative weights under these conditions would be as follows:

Span.	Weight of steel girder.	Weight of iron girder.
200.	57 tons	110 tons
300.	150 "	300 "
400.	320 "	800 "

Again, taking such a case as that of the Menai Bridge, which consists of two spans of 500 feet over the navigable waterway. This structure is composed of four wrought-iron tubular girders, each weighing about 1,500 tons, or 6,000 tons in all; and, to avoid the difficulties of scaffolding, each of these tubes was built on the shore, floated off on pontoons, and lifted bodily into its place by hydraulic machinery. This great work was erected when the application of wrought-iron to engineering works was in its infancy, and when wrought-iron was the only available material for such a purpose. With such materials only at command, and in the then state of knowledge of such structures, the accomplishment of this bridge, capable as it is of carrying railway trains across clear spans of 500 feet, was an achievement far in advance of the time in which it was done, and worthy of the name of its great designer, Robert Stephenson. But if this work had to be constructed now, and were made an open girder of steel instead of plate-iron, the weight of metal required would be little more than one-third of that used, and the cost of erection, the time required for its execution, and the total cost of its construction would be most materially reduced.

It is not alone in the relative weight or in the relative cost that the advantage of the stronger material is important, but with steel we shall be enabled to cross openings which are absolutely impracticable in iron. It will naturally be asked why it is that steel is not used in these structures, if such manifest advantages would result from its employment. The reason is twofold: 1. There is a want of confidence as to the reliability of steel in regard to its toughness and its power to resist fracture from sudden strain. 2. Steel is produced of various qualities, and we do not possess the means, without elaborate testing, of knowing whether the article presented to us is of the required quality for structural purposes. A third reason, arising probably out of those before mentioned, is found in the fact that in the regulations of the Board of Trade relative to railway structures, although rules are given for the employment of cast iron and wrought iron, steel has not, up to the present time, been recognized or provided for.

[TO BE CONTINUED.]

CHICAGO RAILROAD NEWS.

Illinois Central.

In September the company sold 2,633.44 acres of construction lands for \$21,369.03, 120 acres of free lands for \$1,080 and town lots for \$70, making the total sales \$22,519.03. The Land Department collected \$45,958.49 during the month.

The Traffic Department reports as follows:

Estimated Earnings—Traffic Department.

	In Illinois. 707 Miles.	In Iowa. 402 Miles.	Total. 1,109 Miles.
Freight.	\$42,702.06	\$14,370.0	\$57,072.06
Passengers.	125,211.35	48,514.30	173,725.55
Mails.	6,375.00	3,059.24	9,434.24
Other sources.	119,625.01	2,555.76	122,180.76
Total, September, 1873.	\$67,913.23	\$19,499.30	\$87,412.55
Total actual earnings, Sept. '73.	578,459.2	166,292.99	744,752.23
Increase.	\$99,434.1	\$32,306.21	\$131,630.33

This is an increase of 17½ per cent. in the Illinois earnings, 19 per cent. in the Iowa earnings, and 17½ per cent. in the total earnings.

Chicago & Alton.

The railroad bridge at Louisiana is progressing with all practicable speed. This week one span of the superstructure will be in place, and the entire bridge is to be completed by Christmas day at the farthest. This company has paid all the just demands against it on account of the Lemont disaster; although there remains two or three claims which, having no apparent foundation in right, will probably be adjudicated by the courts if the parties to them persist in pushing them. The other day a certain person, desirous of making a point against the road, asked if the company would haul the loaded cars

of an independent transportation company, should such a corporation be formed. The reply was in the affirmative. "But," continued the interrogator, "would you haul such cars if they could transport grain at a lower rate than you require?" The reply was still in the affirmative, "but," said the railroad official, "we should charge something for taking your empty cars back again." This is a good statement of a point that has been overlooked by the public; that vast part of the body politic, however, is beginning to see that there is a question involved in this thing of hauling empty cars, and that somebody must pay for their transportation.

Canada Southern.

The first freight to Chicago over this road arrived in this city October 13, via Toledo and the Toledo, Wabash & Western road to Tolono, and thence on the Illinois Central to Chicago. It is probable that this freight will seek the more direct route by way of the Detroit, Eel River & Illinois Railroad as soon as that shall be completed to a connection with the Lake Shore & Michigan Southern road, which will be accomplished in a few days, as the terminus of the new road is within about two miles of Butler.

General Railroad News.

ELECTIONS AND APPOINTMENTS.

At the annual meeting of the Rockford, Rock Island & St. Louis Railroad Company in Rock Island, Ill., October 8, the following board of directors was elected by a majority of about 10,000 shares over an opposition ticket headed by W. H. C. Green, of Cedar Rapids, Ia.; R. R. Cable, Cornelius Lynde, Milo Lee, F. Weyerhaeuser, Calvin Truedale, Rock Island, Ill.; H. B. Sadler, Coal Valley, Ill.; John Moses, Winchester, Ill.; Hiram Cable, Geo. W. Cable, Davenport, Ia.; Benjamin Stickney, St. Louis. The only change in the board is the election of Mr. Sadler in place of Henry Budge. At a subsequent meeting of the board the old officers were re-elected as follows: President, Ransom R. Cable; Vice-President, George W. Cable; Treasurer, Cornelius Lynde; Secretary, John P. Whitehead.

—Mr. V. K. Moore has been appointed Treasurer of the Burlington & Southwestern Railroad Company, in place of Henry Hatch, resigned.

—The stockholders of the Milwaukee & St. Louis Air Line Railroad Company met in Milwaukee, October 3, and organized by the election of the following board of directors: John H. Van Dyke, Edward F. Allis, George Burnham, John Black, Robert W. Pierce, Guido Pfister, Joshua Stark, Milwaukee, Wis.; Philo Belden, Rochester, Wis.; Charles Kellum, C. W. Marsh, Sycamore, Ill.; J. H. Johnson, Woodstock, Ill.; T. D. Brewster, Peru, Ill.; C. C. Merrick, Chicago.

—At the annual meeting of the Western Union Telegraph Company in New York, October 8, the following board of directors was elected without opposition: William Orton, James H. Bunker, Alonzo B. Cornell, Harrison Durkee, Norman Grier, James Harper, E. D. Harper, Augustus Schell, W. K. Thorne, C. Vanderbilt, Frank Work, Chester W. Chapin, Ezra Cornell, Cyrus W. Field, Wilson G. Hunt, David Jones, C. Livingston, G. H. Mumford, A. H. Palmer, G. M. Pullman, E. S. Sandford, Hiram Sibley, John Steward, Moses Taylor, W. H. Vanderbilt, W. R. Vermilye, E. B. Wesley, Stillman Witt and E. D. Worcester. About \$30,000,000 of the stock was voted on. The directors met October 9 and elected the following officers: President, Wm. Orton; Vice-Presidents, A. B. Cornell, Norvin Green, Augustus Schell, G. H. Mumford, Harrison Durkee; Executive Committee, Wm. Orton, J. H. Bunker, A. B. Cornell, H. Durkee, N. Green, Joseph Harker, E. D. Morgan, Augustus Schell, W. K. Thorne, C. Vanderbilt, Frank Work.

—Mr. W. J. Rotch, of New Bedford, Mass., has been chosen a director of the Boston, Clinton & Fitchburg Railroad Company.

—At the annual meeting of the Valley Railroad Company in Staunton, Va., October 1, the following directors were elected: W. Allen, J. B. Dorman, Rockbridge County, Va.; E. Pendleton, Botetourt County, Va.; M. G. Harman, Staunton, Va.; G. W. Harnsborough, Roanoke County, Va.; R. T. Baldwin, R. Norris, D. H. Miller, John Hopkins, William Keyser, P. P. Pendleton, Baltimore. Messrs. Hopkins, Keyser and Pendleton represent the Baltimore & Ohio Company in the board, and Messrs. Baldwin, Norris and Miller the city of Baltimore. The board subsequently elected officers as follows: President, Robert Garrett; Secretary, George E. Price; Treasurer, W. H. Ijama; Chief Engineer, James L. Randolph; attorneys, Sheffey & Bumgardner.

—At a meeting of the directors of the Quincy, Missouri & Pacific Railroad Company in Quincy, Ill., October 8, Henry Root, of Quincy, was chosen President of the company, in place of Benjamin E. Smith, resigned. D. Paulin, of Quincy, was chosen a director to fill Mr. Smith's place in the board.

—At the annual convention of the Railroad Conductors' Life Insurance Association in Boston, October 9, the following officers were elected for the ensuing year: President, J. W. Seymour, Illinois Central Railroad, Centralia, Ill.; Vice-Presidents, M. Spain Jay and Wm. West; Secretary and Treasurer, Joseph F. Culbertson; Executive Committee, John W. Moore, Edward Morell, W. J. Lacey.

—At a meeting of the directors of the Independent Delaware River Line in New York, recently, the following officers were elected for the ensuing year: President and General Director, C. Wesley Poulsen; General Manager, James H. Redfield; Superintendent, Frank D. Estabrook; Treasurer, William H. Granger; Assistant Treasurer, C. E. Etting, Philadelphia; General Freight Agent, R. Etting; General Passenger Agent, G. E. Goldthwaite; Attorney, P. G. Galpin.

—Hon. George Nichols of Northfield, Vt., has been appointed Clerk of the Central Vermont Railroad Company.

—A corrected list of the directors of the Southern Central Railroad Company is as follows: Elmore P. Ross, J. Newcomb Knapp, William C. Barber, Charles N. Ross, Auburn, N. Y.; J. W. Dwight, Dryden, N. Y.; Clinton T. Backus, Union Springs, N. Y.; Thomas A. Platt, Owego, N. Y.; R. W. Clinton, Newark Valley, N. Y.; H. K. Clark, Groton, N. Y.; Chauncy L. Rich, Richford, N. Y.; Robert A. Packer, Towanda, Pa.; J. A. Timson, Wilkesbarre, Pa.; C. L. Goodwin, Milwaukee, Wis. The officers of the company are as follows: President, Elmore P. Ross; Vice-President, J. W. Dwight; Secretary, J. Newcomb Knapp; Treasurer, Chauncey L. Rich; General Agent, Charles A. Warden, Auburn, N. Y. Mr. J. Milton Brown was recently appointed Auditor, in place of H. N. Lockwood.

—Of the new board of the Toledo, Wabash & Western Company, Milton Courtright, Kenyon Cox, Sidney Dillon, David Dow, Daniel Drew, John Ross and John F. Tracy are directors of the Canada Southern Company; the same, with the exception of John Ross, are directors of the Chicago & Canada Southern, and J. S. Casement is General Manager of the Canada Southern, and W. L. Scott was one of the original directors and most prominent promoters of the Canada Southern project. Thus nine of the fifteen Wabash directors may be counted on as Canada Southern men. All of these but Scott, however, were members of the old Wabash board. Augustus Schell and Wm. L. Scott are members of the Lake Shore directory, and were in the previous Wabash directory, together with the late Horace F. Clark, the Lake Shore President. The Canada Southern

thus gains one and the Lake Shore loses one in the new board, while the Canada Southern—including Scott, who is also a Lake Shore director—has a three-fifths majority in the board of its own officers. Courtright, Dow, Scott and Tracy, of the new Wabash board, are also Chicago, Rock Island & Pacific and Chicago & Northwestern directors. Mr. P. L. Cable is, we believe, a very wealthy coal-owner, and father of the three Cables in the Rockford, Rock Island and St. Louis

Central, of New Jersey.

—Mr. Gh. J. Quetil, C. E., formerly Principal Assistant Engineer of the Texas & Pacific Railway, who, while in that capacity, made the plans for that company's shops at Marshall, Texas, has begun the work of making plans for the shops of the Pittsburgh, Washington & Baltimore Railway shops which are to be constructed next year at Connellsburg, Pa.

PERSONAL.

—Mr. L. Pearson, who recently resigned the position of Superintendent of the Evansville, Terre Haute & Chicago road to accept that of Superintendent of the Chicago, Danville & Vincennes, was presented with a valuable watch and chain by the employees of his old road at Evansville, Ind., October 4.

—Mr. Shanks, Roadmaster, and William B. Fletcher, Master Bridge-builder, of the Connecticut and Passumpsic Rivers Railroad, have resigned their respective positions.

TRAFFIC AND EARNINGS.

—In one day, October 10, 3,463 cars passed westward over the Middle Division of the Pennsylvania Railroad, from Harrisburg to Altoona.

—The heaviest shipments of petroleum from Harrisburg, Pa., to New York in a single day were made October 8, when 135 tank cars, carrying 8,775 barrels of oil, left Harrisburg by the Allentown line.

—During the year ending August 31, 1873, the elevators on the line of the St. Paul & Pacific Railroad handled 1,218,819 bushels of wheat. During the same period, 1,309,210 bushels were shipped at stations along the line of the St. Paul & Sioux City road.

—The earnings of the St. Louis & Southeastern Railway for the month of September were: 1873, St. Louis Division, \$81,219.11; Nashville Division, \$42,492.57; total, \$123,713.76; 1872, total, \$93,223.11; increase, \$30,490.65, or 32% per cent.

—The earnings and expenses of the Union Pacific Railroad for the month of August were as follows:

	1873.	1872.	Increase.	P. C.
Gross earnings.....	\$337,273.29	\$789,567.56	\$47,710.73	6
Expenses.....	40,947.36	35,45.5.52	42,421.84	11%

Net earnings..... \$436,331.93 \$31,012.04 \$5,228.89 1%

For the eight months ending August 31 the earnings and expenses were as follows:

	1873.	1872.	Increase.	P. C.
Gross earnings.....	\$6,297,087.95	\$5,574,566.70	\$922,521.25	17.16
Expenses.....	3,191,044.21	3,103,503.10	87,541.11	2.13-16

Net earnings..... \$3,106,043.74 \$2,271,063.60 \$834,989.14 38%

The expenses in 1873 were 50% per cent. of earnings, and in 1872, 57% per cent. The earnings per mile for the eight months were \$6,102 in 1873 and \$5,208 in 1872.

—The earnings of the Kansas Pacific Railway for the fourth week in August were: passengers, \$35,621.85; freight, \$75,014.44; mails, \$2,055.32; total, \$112,691.61. Of this amount \$2,923.98 was for transportation of troops, mails and government freight.

—The earnings of the Denver & Rio Grande Railway (main line, 118 miles) for the fourth week in September were: passenger, \$5,549.95; freight, \$5,255.05; mails, \$123; express and miscellaneous, \$51.59; total, \$11,019.59. Of this amount, \$156.90 was for transportation of troops, mails and government freight. For the same week in 1872 the earnings were \$11,724.27; decrease, \$704.68, or 6 per cent. In 1872 the earnings included \$2,879.36 for contractors' freight.

—The earnings of the Denver & Rio Grande Railway (main line, 118 miles) for the month of September were: 1873, \$31,930; 1872, \$32,035; increase, \$2,715, or 8% per cent.

—The earnings of the Colorado Central Railroad for the three months ending July 31 were as follows:

Earnings (\$1,668 per mile).....	\$70,043.49
Expenses (47% per cent.).....	33,450.16

Net earnings (\$871 per mile)..... \$36,593.33

—The following is a report of the number of trains passing over the Delaware Division (from Port Jervis to Susquehanna) of the Erie Railway, for the six days from September 22 to September 27, both inclusive: Westward bound, 181 trains, carrying 263 passenger-train cars, 970 loaded and 1,513 empty freight cars and 3,482 empty coal cars—in all, 5,972 freight-train cars. Eastward bound, 181 trains, carrying 243 passenger-train cars, 2,438 loaded freight cars and 3,498 loaded coal cars—in all, 5,936 freight-train cars. The whole train movement was 362 trains, with 506 passenger-train and 11,908 freight-train cars, a daily average of 60 trains, with 84 passenger-train and 1,985 freight-train cars.

—The earnings of the Chicago & Northwestern Railway for the first week in October were: 1873, \$309,328; 1872, \$335,911; decrease, \$26,583, or 7% per cent.

—The receipts of bituminous coal at East St. Louis for the month of September were: Belleville & Southern Illinois Railroad, 3,277 car loads; Ohio & Mississippi, 1,646 car loads; Illinois & St. Louis, 1,562 car loads; Vandalia Line, 1,455 car loads; St. Louis & Southeastern, 1,118 car loads; total, 9,058 cars, carrying 2,502,233 bushels, or 89,365 tons.

OLD AND NEW ROADS.

Texas & Pacific.

Trains on the Jefferson Division are now running to Moore's Landing, 45 miles northeast of Jefferson and seven miles beyond the late terminus. There remains 14 miles of track to be laid to reach Texarkana.

It has been reported, on the authority of a private telegram, that the President of the company, Mr. Thomas A. Scott, has made arrangements for disposing of \$44,000,000 of the company's bonds in Europe.

The track on the Transcontinental Division has been laid to Quincy, Tex., 34 miles east of Sherman.

It is stated that a large number of the employees have been given 60 days' leave of absence.

Atlantic & Great Western.

The passenger travel over the road is stated to be heavier this season than for some years past.

The grading is nearly completed for an extension of the Shenango Branch (formerly the Shenango & Allegheny road) for 15 miles southeast of its present terminus at Harrisville, Pa. The business of this branch is increasing rapidly, the shipments of oil being very large.

General McClellan, President of the company, sailed for Europe recently. It is reported that the object of his visit is to

be present at the conference between the representatives of the Erie and Atlantic & Great Western companies. It is also reported that the Atlantic & Great Western will soon be leased to the Erie.

Central, of New Jersey.

The grading for the permanent line of the Newark & New York road through Bergen Hill has made considerable progress this season. The rock cutting is substantially completed from West Bergen to Bergen avenue station, except for about 100 yards, where the cutting is as yet only wide enough for single track. From Bergen Avenue to Lafayette the rock cutting is nearly all finished, and the earth cutting has made considerable progress. The work is being done in a very substantial manner. It has been necessary to build retaining walls in most of the earth cut east of Bergen avenue.

Canada Pacific.

Late dispatches state that an arrangement has been effected by which this company will surrender its charter to the Canadian government. This action is taken in consequence of the scandals connected with the organization of the company, and the strong opposition to it which has sprung up.

St. Joseph & Denver City.

This road has been taken possession of by the United States Marshal for Kansas under orders from the United States Circuit Court, in a suit commenced by some of the creditors of the company.

Burlington & Southwestern.

A supply of iron has been received, and tracklaying beyond the present terminus at Unionville, Mo., will shortly be resumed.

California Central Narrow Gauge.

The work of grading is progressing steadily. Soundings are being made along the water front at Benicia, Cal., for the company's wharf, work on which is soon to be commenced. It is stated that iron has been purchased in England, and the company expects to have the road opened from Benicia to Vacaville, 30 miles, by June 1, 1874.

Hanibal, Moulton & Minnesota.

A company by this name has been organized to build a railroad from Hannibal, Mo., northwest through Missouri and Iowa into Minnesota, with a branch line to Des Moines, Ia. The capital stock is to be \$10,000,000.

Springfield & Longmeadow.

By authority of the directors, the Vice-President of the Connecticut Central Company has given the bond of the company to the amount of \$100,000 to the city of Springfield, Mass., guaranteeing that the Connecticut Central main line and its branch to Rockville shall be completed within one year after the completion of the Springfield & Longmeadow road. It is now expected that Springfield will appropriate to the Longmeadow road the \$100,000 voted for a line to Rockville.

The Springfield & Longmeadow road is to constitute the northern end of the Connecticut Central, from the Massachusetts State line to Springfield.

La Crosse Bridge.

It is now stated that parties are ready to furnish the means to build the bridge at La Crosse, Wis., as soon as the Bridge Company or the city can arrange for an eastern connection from the bridge. La Crosse papers state that the Chicago & Northwestern Company will build a branch into La Crosse, thus giving the bridge an eastern connection, provided that the city will give a sufficient bonus. The La Crosse people do not seem disposed to add anything to the \$150,000 already voted in aid of the bridge, and it is proposed to set apart \$50,000 of that amount as a bonus for the construction of a branch of the Northwestern.

Portland & Oxford Central.

The Maine Railroad Commissioners have applied to the courts at Portland, Me., for an injunction to restrain this company from running trains over its road unless certain needed repairs are made. The Commissioners have examined the road twice, and find it in very bad condition. This is regarded as a test case, and will probably decide how far the powers of the Commissioners extend under the law.

The road is 27½ miles long, and extends from Mechanics' Falls, on the Grand Trunk, northward to Canton. The road has been in poor condition for some time, and legal proceedings were commenced against the company by the Commissioners last year.

Paris & Decatur.

It is said that arrangements have been made to extend this road from its present terminus at Paris, Ill., east by south to Terre Haute, Ind., a distance of 19 miles. The St. Louis, Alton & Terre Haute road now connects the two points.

Chicago, Burlington & Quincy.

The Burlington (Ia.) Hawkeye denies the report that the railroads at that place were to be broken up and the men transferred to the Aurora shops. The workmen on passenger coaches have all been transferred to Aurora, but the freight-car shops and the locomotive-repair shops are to be retained in Burlington.

Winona & St. Peter.

This company offers to give ground at any of its stations to any parties desiring to build warehouses or elevators for wheat. Application is to be made to the Assistant Superintendent.

Baltimore & Ohio.

An order has been issued authorizing the shipment of milk on passenger trains from any regular station. The rate to be charged is 2½ cents per gallon for any distance under 50 miles and 3 cents per gallon for any distance exceeding 50 miles.

Canada Southern.

The line from Buffalo to Toledo and Detroit and the St. Clair Branch are to be opened for passenger travel about November 1.

Manchester & Camden.

This company has purchased the ferry across the Delaware from Philadelphia to Kaighn's Point, Camden. The Camden terminus will be located at Kaighn's Point.

Des Moines Valley.

The Purchasing Committee of the bondholders requested that holders of the first mortgage and of the land-grant mortgage bonds deposit their bonds with the Farmers' Loan and Trust Company, New York, before the 15th instant, preparatory to purchase of the property under foreclosure and under the terms of the agreement which has been signed.

West Wisconsin.

This company has recently released the mortgages held by it on 20,000 acres of land held under \$100,000 worth of land-grant bonds, which have been canceled by the trustees.

Illinois River Improvement.

The work on the foundation of the lock at Copperas Creek on the Illinois River is progressing rapidly and will be completed this year. The work is now being carried on under an appropriation made by Congress, but by the bill passed by the Illinois Legislature last winter the net revenues of the canal

are appropriated to the same work, and contracts will be let as soon as these reach \$100,000. It is not doubted that this sum will be accumulated by the time the canal is closed, and if so, the work will proceed without interruption.

Detroit & Bay City.

The bridge over the Saginaw River between Bay City, Mich., and Wenona is completed, and connection has been made with the track of the Jackson, Lansing & Saginaw at Wenona. Cars from the latter road can now be run directly through to Detroit, over the Detroit & Bay City road.

Portland & Kennebec.

In the statement given last week of the terms on which the stock of the Portland & Kennebec Company is to be exchanged for Maine Central consolidated bonds, the rate of exchange should have read "\$100 in stock for \$88 in bonds" instead of "\$100 in bonds for \$88 in stock," as printed.

Vermont Central.

Very few claims have thus far been presented to the Chancery Commission appointed to audit claims against the Vermont Central road. The old trustees are coming to terms with the creditors wherever it is possible to do so, thus keeping the claims from coming before the Commission.

Hoosac Tunnel.

During the month of September the heading from the central shaft westward was advanced 184 feet, and that from the western end eastward 133 feet. The total distance opened from the east portal westward is 14,577 feet, and from the west portal eastward 9,902 feet, a total of 24,479 feet, leaving only 552 feet to be opened.

Proposals are advertised for by the State of Massachusetts for building three wooden truss bridges on the line from the tunnel westward to North Adams. Proposals are to be addressed to Benjamin D. Frost, State Engineer, at North Adams, Mass.

New York & Oswego Midland.

Mr. A. S. Hewitt, Receiver of this road, has made a statement that the current expenses of the road shall be paid promptly, and that all arrears due employees will be paid off as fast as possible. He has already commenced the payment of wages due from September 18, the date of his appointment.

The work on the new shops at Middletown, N. Y., is going forward. The grading of the grounds is progressing rapidly, and the framing of the timbers for the round house is nearly finished.

Brockford, Rock Island & St. Louis.

At a recent annual meeting a strong effort was made, under the lead of Mr. Greene, of Cedar Rapids, Ia., to put out the present board of directors, but was unsuccessful. After the election was over and the stockholders had adjourned, an injunction was served on the Greene party, restraining them from voting upon or transferring their stock on the ground that it had been fraudulently issued and obtained, the object of which was to prevent any further attempt to control the policy of the company by means of that stock, and have the same set aside as fraudulent. It is asserted that the Greene party desired to obtain control for the purpose of settling the suits commenced some time since against Henry A. Boody to recover a large sum of money alleged to have been fraudulently obtained.

Mansfield, Coldwater & Lake Michigan.

It is reported that the section from Monteith, Mich., southeast to Battle Creek on the Chicago and Lake Huron road, a distance of about 25 miles, is to be ironed this year.

Saginaw Valley & St. Louis.

A new round house is being put up at St. Louis, Mich., and the present engine house is to be used as a repair shop. A pumping engine has been put up and many minor improvements made.

Winter Time Tables.

A meeting of superintendents of the trunk lines was held at the Galt House, Louisville, Ky., to arrange a winter schedule for through trains. Twenty-seven roads were represented. Mr. E. S. Flint of the Cleveland, Columbus, Cincinnati & Indianapolis was chosen Chairman and J. N. Abbott, General Passenger Agent of the Erie, Secretary. The schedule adopted makes no material change in time, the trains being allowed a little longer to run, and goes into effect November 2. A resolution that no road represented in the convention and agreeing to the schedule shall change so as to break the connection agreed on, without giving ten days' notice to connecting and competing lines, was voted down.

Rochester & State Line.

The iron is being delivered at both ends of the line, at Rochester and Salamanca, and preparations for tracklaying are being made. Two locomotives from the Brooks Locomotive works at Dunkirk and a number of cars have been delivered. It is hoped that the cars will run from Rochester to Salamanca this year.

Erie.

The Buffalo Commercial of October 7 says:

"The Erie Railway Company's civil engineers have just completed the preliminary surveys for a new line through Western New York from Portage Bridge to Buffalo. The route starts from Portage, follows the Eastoe Creek through Wyoming County, passes through the villages of Jaya Center and Stricker'sville, then enters Erie County, passing through Wause, two miles north of the village of Aurora, through the township of that name, thence following the Buffalo Creek through the townships of Marilla and Lancaster, and so on to Buffalo. The route surveyed has not yet been adopted by the company, and we are uninformed as to whether it will be or not."

"A rumor has prevailed extensively that the Erie Railway intend to use the new route, in order to avoid Portage Bridge. This we are assured is without foundation; the bridge was never in better condition, and the company have no idea of dispensing with it."

"The new route, if adopted and built according to the surveys just made, will not in any way interfere with the present line. It is not intended as a substitute for, but rather as auxiliary to, the line now used."

Portage is on the Buffalo Division, 61 miles from Buffalo, and from that place the present line turns northward and runs a little west of north for 23 miles to Linden, and thence nearly due west to Buffalo. The new line, with the present road from Hornellsville to Portage, would form a nearly direct line from Hornellsville to Buffalo, some 10 miles shorter than the present road.

Valley of Virginia.

At the annual meeting of this company in Staunton, Va., October 1, the President made a report of the present condition of the work. The road from Harrisonburg, Va., to Staunton is almost completed, and tracklaying is to be commenced at once. The whole line south of Staunton has been placed under contract to Messrs. Mason, McMahon, Menefee, Harman and Shanahan, who have agreed to take the bonds at even a more favorable rate than was named in the Johns Hopkins negotiations. The company has effected a mortgage for \$3,000,000, the bonds for which will be issued from time to time, and will, he says, rank high in the market. The receipts of the company for the year, up to September 1, were \$593,424.23, and the disbursements, \$586,697.33, leaving a balance in the treasury

of \$6,777.50. The President recommended an additional call for 30 per cent, on the stock subscriptions. The estimated cost of the whole line from Staunton to Salem is \$7,700,000. After some discussion a resolution was adopted authorizing the board of directors to make such assessments as were deemed necessary and directing the board to determine the line through Botetourt County as soon as possible. A resolution was also adopted, authorizing the board of directors to lease such portion of the road as may be completed before the next stockholders' meeting, for a time not longer than three years, or to make other provisions for the prompt and profitable working of the same.

Railroad Taxation in New Jersey.

The Erie Railway Company and the various companies owning its line in New Jersey—the Paterson & Hudson River, Paterson & Ramapo, Paterson & Newark, Newark & Hudson, Northern and Long Dock companies—have filed in the office of the Secretary of State of New Jersey their acceptance of the act passed by the Legislature last winter providing for the uniform taxation of railroad companies.

Pennsylvania—New York Division.

Trains have commenced running over the new line from the east end of Bergen Cut to the Harsimus docks. Some trouble has been experienced from the sinking of the trestle work across the meadows, where it is built on piles. It was supposed that the piles were of sufficient length to carry any required weight, but in several places they have sunk as much as six inches.

Washington City, Virginia Midland & Great Southern.

The track on the extension from Lynchburg, Va., to Danville is laid for 24 miles southward from Lynchburg. The work is progressing steadily, and arrangements have been made for the tracklaying to continue without interruption.

St. Louis & St. Charles.

This company has been organized to build a branch of the St. Louis & Florissant narrow-gauge northward to St. Charles. This branch will be 14 miles long. The capital stock is to be \$200,000, and the incorporators are John L. Ferguson, James Miller, John H. Shackleford, Richard Berry, John H. Terry, Wm. H. Thorburn, Thos. J. Thompson and Erastus Wells. The St. Louis, Kansas City & Northern road already connects St. Louis with St. Charles.

Boston, Clinton & Fitchburg.

The board of directors has resolved to increase the equipment by ordering five new locomotives and 250 coal cars. The coal traffic of the road from New Bedford to the interior towns is increasing rapidly.

Lewiston & Auburn.

The grading is completed from the Grand Trunk Junction to Taylor's Brook. The work of constructing the road under the Maine Central track at the crossing is now going on. It is a work of considerable difficulty.

Chesapeake & Ohio.

Since the completion of this road, there have been opened along the line 17 coal mines and seven iron-ore beds, and 12 blast furnaces have been built. The new furnaces completed and in course of erection will have a total annual product of 120,000 tons of pig iron.

Denver & Boulder Valley.

Regular trains are now running over the extension to Boulder, Col. In that place a donation of 15 acres of land has been made to the company, and a commodious depot is to be erected.

Watchung.

It is reported that responsible parties have offered to buy and complete this road. Work is to be commenced at once if the offer is accepted. The road is a branch of the Montclair, and extends from that road near Woodside, N. J., westward to Orange. It is about five miles long, and a large part of the grading and bridging was completed some time since, but work was discontinued last spring.

Chicago & Lake Huron.

The connection with the Pittsburgh, Fort Wayne & Chicago road at Valparaiso, Ind., has been completed. Trains were to have commenced running through from Lansing, Mich., to Chicago, October 13.

Long Island Narrow Gauge.

A project is on foot for the construction of a railroad of 3-foot gauge from Hunter's Point (opposite New York) eastward along the north shore of the island to Huntington. The distance is about 30 miles.

Northern Pacific—Pacific Division.

The tracklayers on the extension to Tacoma, W. T., have reached a point five miles beyond the Nisqually bridge, and 23 miles from Tenino, the old terminus. The tracklaying at that point was suspended to await the arrival of more iron. The iron for the remaining 16 miles has been shipped from San Francisco. The grading is completed to the water side at Tacoma, and the grading parties are now at work on the yards and town site at that place. Work is shortly to be commenced at the company's wharf at Tacoma.

Cairo & Fulton.

The United States courts at Little Rock, Ark., have refused to issue an injunction to compel the suspension of work on the bridge over the Arkansas River at Little Rock.

Indianapolis, Bloomington & Western.

Local papers report that a contract has been let for the grading of 25 miles of the extension from the Illinois River at Havana, Ill., westward toward Quincy.

Kansas Pacific.

The Arkansas Valley Branch is now completed and opened for travel to Las Animas, Col., on the south side of the Arkansas River. This branch is 54 miles long, and extends from Kit Carson (152 miles east of Denver) southwest to Las Animas. Extensive stock yards are to be put up at that point. The company is making a strong effort to secure the New Mexican trade, the branch, indeed, having been built chiefly with that object. The Atchison, Topeka & Santa Fe is now a competitor for that trade.

Pittsburgh, Virginia & Charleston.

Trains are now running from Pittsburgh, Pa., to Monongahela City, 32 miles southeast. Beyond that point there is little or no work done on the road.

Philadelphia & Reading.

An extension of the Perkiomen Branch from Green Lane, Pa., to Pencsburg, five miles, was opened for travel October 6. The whole length of the Perkiomen road is now 28 miles, from Perkiomen Junction to Pencsburg. About 350 men are at work on the extension from Pencsburg to Emmaus on the East Pennsylvania road.

Houston & Texas Central.

It is reported that negotiations are going on for the sale by this company to the Missouri, Kansas & Texas of the section of road from Denison, Tex., south to Sherman, the crossing of the Transcontinental Division of the Texas & Pacific. From Sherman to Denison the distance is nine miles, and the Houston &

Texas Central track extends three miles north of Denison to Red River city.

Green Bay & Minnesota.

Track is now laid to Arcadia, Wis., 44 miles southwest of Merrillan. Only 16 miles of track remain to be laid to the junction with the La Crosse, Trempealeau & Prescott road, over which trains are to run into Winona. The whole working force is now concentrated on this section.

Union Pacific.

The report of the Land Department for the month of September shows that the sales of land during that month amounted to 20,230.51 acres for \$126,970.86, an average price of \$6.276 per acre. The total sales of land up to October 1, 1873, were 799,748.73 acres for \$3,595,460.63, an average price of \$4.50 per acre. The whole land grant is about 12,000,000 acres.

Dividends.

The Baltimore & Ohio Railroad Company has declared a dividend of 5 per cent. on the stock of the Main Stem and the Washington Branch for the half-year ending September 30, 1873. The dividend of the Main Stem is payable November 15, and that on the Washington Branch stock October 31.

The Chicago, Rock Island & Pacific Company has declared a dividend of 4 per cent., payable November 26. The transfer books will be closed November 11.

New Mail Routes.

Mail service has been ordered over the Montclair Railroad from Jersey City to Ringwood Furnace, 36 miles.

Mail service has been ordered over the Lake Erie, Evansville & Southwestern Railroad from Evansville, Ind., to Booneville, 18 miles.

An extension of mail service has been ordered over the West Wisconsin Railway from Warren's Mills to Elroy, 32 miles.

Meetings.

The annual convention of the Grand International Division of the Brotherhood of Locomotive Engineers met in Philadelphia, October 15.

The annual meeting of the Western Maryland Railroad Company was held in Baltimore, Md., October 15.

The annual meeting of the Camden & Atlantic Railroad Company will be held at the company's office in Camden, N. J., October 23.

Utica & Black River.

The new line to Clayton on the St. Lawrence River was formally opened for traffic by an excursion over the line September 30. Regular freight and passenger trains commenced running to Clayton, October 1.

Wallkill Valley.

It is stated that arrangements have been made with the bondholders by which the present board of directors will retain the management of the road for another six months.

Ouachita Valley.

Work on this road has been suspended for the present. The road extends from the Cairo & Fulton near Arkadelphia, Ark., southeast to Camden.

Midland Pacific.

The United States Circuit Court at Omaha has issued an injunction restraining Merrick County, Neb., from issuing \$100,000 in bonds lately voted to the Midland Pacific road. The injunction was applied for by the Union Pacific Company.

Stratford & Lake Huron.

The town of Stratford, Ontario, has voted \$60,000 in aid of this projected road, which is to extend from Stratford, the junction of the main line and Buffalo Division of the Grand Trunk, northward to Owen Sound on Georgian Bay. An effort has been made to interest the Grand Trunk Company in the project, and the assurance has been given that that company would provide the rolling stock and operate the road, and would render as much assistance as possible in its construction, provided the 4 feet 8½ inches gauge was adopted.

THE SCRAP HEAP.

James F. Joy's Opinion.

The Detroit Free Press has asked Mr. James F. Joy's opinion concerning the effect of the financial troubles on railroads, which it reports as follows:

"Passing briefly over such details as concern merely the operating of roads and the general inclination to curtail expenses in view of the difficulty of obtaining currency, Mr. Joy spoke strongly of the sudden check upon railroad construction. He thinks the difficulty arises from the vast sums of money which have been going into railroads, many of which are without merit, and many of which cannot be profitable or remunerative for a long time to come. He is strong in the conviction that it will almost totally stop every work now in progress, and that no new ones can be undertaken very soon."

"There is everything, Mr. Joy thinks, to discourage capitalists from putting money into this kind of investment. While the railroads have added to the value of the Western country thousands of millions of dollars, made the country rich, and built up towns and cities everywhere, they are treated as a sort of public enemy. The men who have put their money into them are by too many treated and considered as extortionists and robbers. Even in this State, which is not half developed, and where at this time there is not a single road paying a fair interest on the cost of it, and most of them not half the interest, there exists this feeling, and capitalists are rapidly coming to feel that this kind of property is not a safe investment."

"In the light of these facts, of the existence of which he believes there is no doubt, Mr. Joy emphatically reiterated his belief that all improvements of this kind are at present at an end in Michigan. He regretted this very much, but in the present state of affairs there is no hope of any other result."

Railroad Manufactures.

The Pennsylvania Iron Works, at Danville, Pa., claim the honor of having turned out the first T rails made in the United States. The first rail of this pattern was rolled October 8, 1845, for the Harrisburg & Lancaster Railroad.

The Dickeson Manufacturing Company, at Scranton, Pa., has reduced its force one-fourth in consequence of the countermanding of several orders for locomotives.

The Tredegar Company at Richmond, Va., has discharged a large number of men from its car shop.

The Ohio Falls Car Company, at Jeffersonville, Ind., which employs 700 men, has stopped all work except in the foundry. The Southwestern Car Company, at Jeffersonville, has also reduced its force considerably.

The "Jones Bridge" Patent.

The case of Westlake vs. Carter, for infringement of the patent taken out by J. L. Jones, and known as "Jones Bridge," has just been tried before Judge Treat, in the United States Circuit Court at St. Louis. The trial occupied three days and a part of a fourth day, and was for \$150,000 damages. The defendants—M. S. Carter & Co., a well-known firm—successfully showed that there was no infringement. The plaintiff moved for a new trial, but we are informed that the weight of the evidence, seen from their own witnesses, was strongly against them.